FARM MECHANIZATION IN THE SOVIET UNION

REPORT OF A TECHNICAL STUDY GROUP

 AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

An Agreemer ments of the United States of Amer les for exchanges in the cultural, te This Agreement is regarded as a s lerstanding between the peoples of t

Agriculture, es of the two countries, was spec ange of specialists. The United Stat Soviet Union in 1958 six technical st ricultural Economics; Agricultur hanization of Agriculture; and Cc nned to send three additional stud ing, and Millwork; Sheep Raising; and Biological Control of Agricultural Pests.

The Soviet Union in turn sent to the United States in 1958 six delegations of specialists in the following subjects: Farm Mechanization; Hydro-Engineering (Irrigation) and Reclamation; Animal Husbandry; Cotton Growing; Agricultural Construction and Electrification; and Veterinary Science. In 1959 three additional Soviet teams are expected in the following fields: Mixed Feeds; Forestry, Lumbering, and Millwork; and Horticulture.

Each United States exchange study group, on completion of its assignment, prepared a report for publication. This report of the exchange delegation of agricultural engineers was prepared by: K. D. Butler, AVCO Corp., Ithaca, N. Y.; A. W. Cooper, Director, National Tillage Machinery Laboratory, Agricultural Research Service, Auburn, Ala.; C. W. Hall, Michigan State University, East Lansing; W. H. Worthington, John Deere Tractor Research and Engineering Center, Waterloo, Iowa; L. W. Hurlbut, University of Nebraska, Lincoln; and W. M. Carleton, Agricultural Research Service, Beltsville, Md.

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FARM MECHANIZATION IN THE SOVIET UNION

Report of a Technical Study Group

The farm mechanization technical study group from the United States arrived in Moscow on August 20, 1958, for a stay of 30 days. We were met at the airport by five representatives of the Ministry of Agriculture. The interpreter from the Ministry was thoroughly conversant with farm machinery terminology.

On the day following our arrival we met with the Russian representatives in the Ministry of Agriculture to discuss the program and itinerary. We made suggestions of places we would like to visit and, in retrospect, it appears that we were permitted to visit most of the places we requested.

The Soviet Union consists of 15 Republics including Russia, the largest Republic. It occupies one-sixth of the land surface of the world and has a population of 200 million people. At present the U.S.S.R. has about 10 percent more tillable acres than the U.S.A. Although Russia is not overpopulated (30.2 people per square mile), it needs additional food supply. Most of the U.S.S.R. is north of the U.S.A., and much of the land is not now used productively for farming. About 56 percent of the people live on farms, but mechanization of agriculture, planned by GOSPLAN, the overall state planning commission for the U.S.S.R., and financed from the government treasury, is resulting in rapid reduction in farm population.

Machinery from the U.S.A. has been used as a pattern for Russian machinery for many years. This is evident from the designs of older machines, in particular, and a few of the new machines. Personnel at research and teaching institutes for agricultural engineering are working closely with designers, testers, manufacturers, and users to

Figure 1.--Route of the U.S.A. Farm Mechanization Team in the U.S.S.R.--Moscow, Minsk, Kiev, Zaporozhe, Kharkov, Rostov-on-Don, Krasnodar, Barnaul, Shipunovo, Moscow. (BN-8897)

improve old models and develop new models of tractors and other machinery. Government financing and the administrative structure connect all agencies. The system is difficult to understand at first glance, but it incorporates competition between various agencies; for example, it does not make the testing agency responsible to the designer.

The machinery manufactured in the U.S.S.R. is on display at the All-Union Agricultural and Industrial Exhibition, which occupies an impressive 500-acre area in Moscow. This very interesting and well-planned exhibition contains examples of practically all the machines, tractors, industrial equipment, farm crops, and types of livestock in the U.S.S.R. Among the exhibitors are collective and state farms, republics, territories, regions, and scientific groups.

One of the displays was a large moldboard plow, which can plow 1 meter deep. The Russians plan to plow to a depth of 1-1/2 meters to improve soil conditions on many limestone soils in Crimea.

A number of trailing and mounted moldboard plows, ranging up to the 6-bottom mounted plow (3-point hitch) designed for their crawler tractor, were on display. The depth of plowing is generally 22 to 25 centimeters for grain crops and 30 to 35 centimeters for sugar beets. Some bottoms were 35 centimeters wide and could plow to a maximum depth of 25 centimeters.

Also displayed was the equipment used in the Maltsev system of cultivation, a large-size artist's impression of the equipment, and a description of the system, which was developed for the Trans-Ural section of the U.S.S.R.[1] It was described as loosening the soil to a depth of 40 to 50 centimeters with a "moldboardless" plow once in 4 years, and cultivating with a "baby duckfoot" sweep plow and a spike-tooth harrow every year.

In addition to machines presently manufactured, many experimental and prototype machines were displayed. An example was a tractor equipped with springs and shock absorbers on the front axle to permit it to travel at high speeds. It was also equipped so that the rear wheels could be shifted in and out hydraulically while the tractor is moving.

Last year 8 million people attended the exhibition. In addition to chairmen of collective farms, directors of State farms, and other representatives of agriculture and industry were visitors from many countries but particularly those bordering the Soviet Union. It is worth the time of any visitor to the Soviet Union to spend 1 or more days at this exhibition.

Figure 2.--The U.S.A. farm mechanization team outside the home of T. I. Tretyakov, Director of the Milk State Farm, near Barnaul in Siberia, Sept. 12, 1958. Left to Right: K. D. Butler, W. H. Worthington, A. W. Cooper, Director Tretyakov, W. M. Carleton, C. W. Hall, and L. W. Hurlbut.

ORGANIZATION AND MANAGEMENT OF THE PRODUCTION AND DISTRIBUTION OF FARM EQUIPMENT

Organization and management in the U.S.S.R. and in the U.S.A., whether in an educational institution, in industry, or elsewhere, are quite different.

Everything in the U.S.S.R. operates in conformity to an overall state plan. There are plans for virtually everything; and the production and distribution of farm equipment, with a supporting educational system for the training of personnel to mechanize agriculture, are no exceptions.

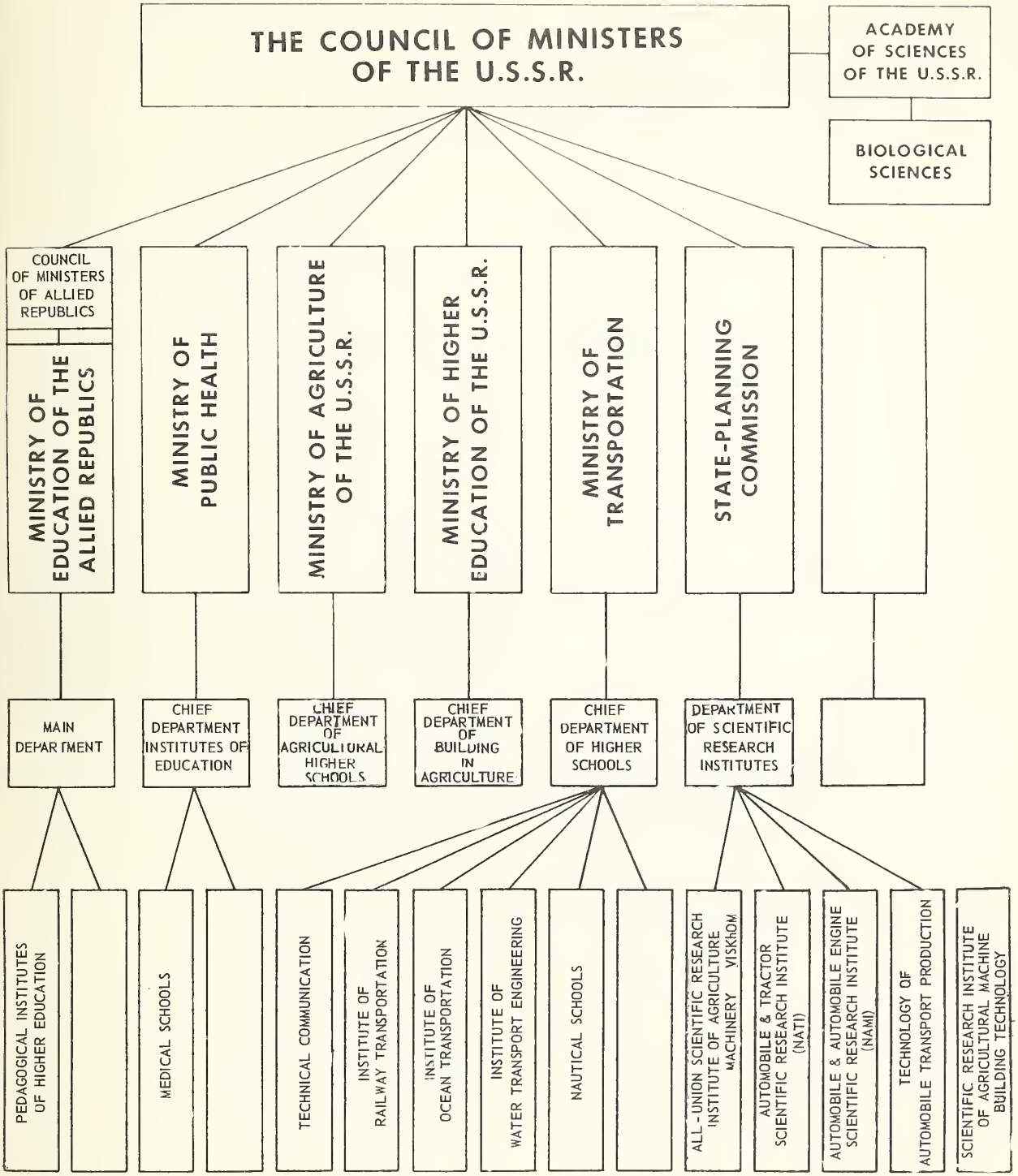
The organizational setup is illustrated in charts 1 and 2.

The top academic leaders are assembled at the University of Moscow and in the U.S.S.R. National Academy of Science. These are parallel to each other and responsible to the Presidium.

The Lenin Academy of Agricultural Sciences in Moscow is the principal agricultural academic center and is not under the Ministry.

Under the Ministry are the Timiryazev Agricultural Academy, an important agricultural training center, and the Bauman Higher Technical School, the top agricultural teaching institute in the U.S.S.R. Both are in Moscow.

[1] I. V. Tyurin. Original article appeared in Pockvovedenia 8: 1-11. 1957. Translation in Soils and Fertilizers, vol. 20, no. 6, 1957; published by Commonwealth Bureau of Soil Science, Farnham Royal, Bucks, England.


THE COUNCIL OF MINISTERS OF THE U.S.S.R.
ACADEMY OF SCIENCES OF THE U.S.S.R.
BIOLOGICAL SCIENCES
COUNCIL OF MINISTERS OF ALLIED REPUBLICS
MINISTRY OF EDUCATION OF THE ALLIED REPUBLICS
MINISTRY OF PUBLIC HEALTH
MINISTRY OF AGRICULTURE OF THE U.S.S.R.
MINISTRY OF HIGHER EDUCATION OF THE U.S.S.R.
MINISTRY OF TRANSPORTATION
STATE-PLANNING COMMISSION
MAIN DEPARTMENT
CHIEF DEPARTMENT INSTITUTES OF EDUCATION
CHIEF DEPARTMENT OF AGRICULTURAL HIGHER SCHOOLS
CHIEF DEPARTMENT OF BUILDING IN AGRICULTURE
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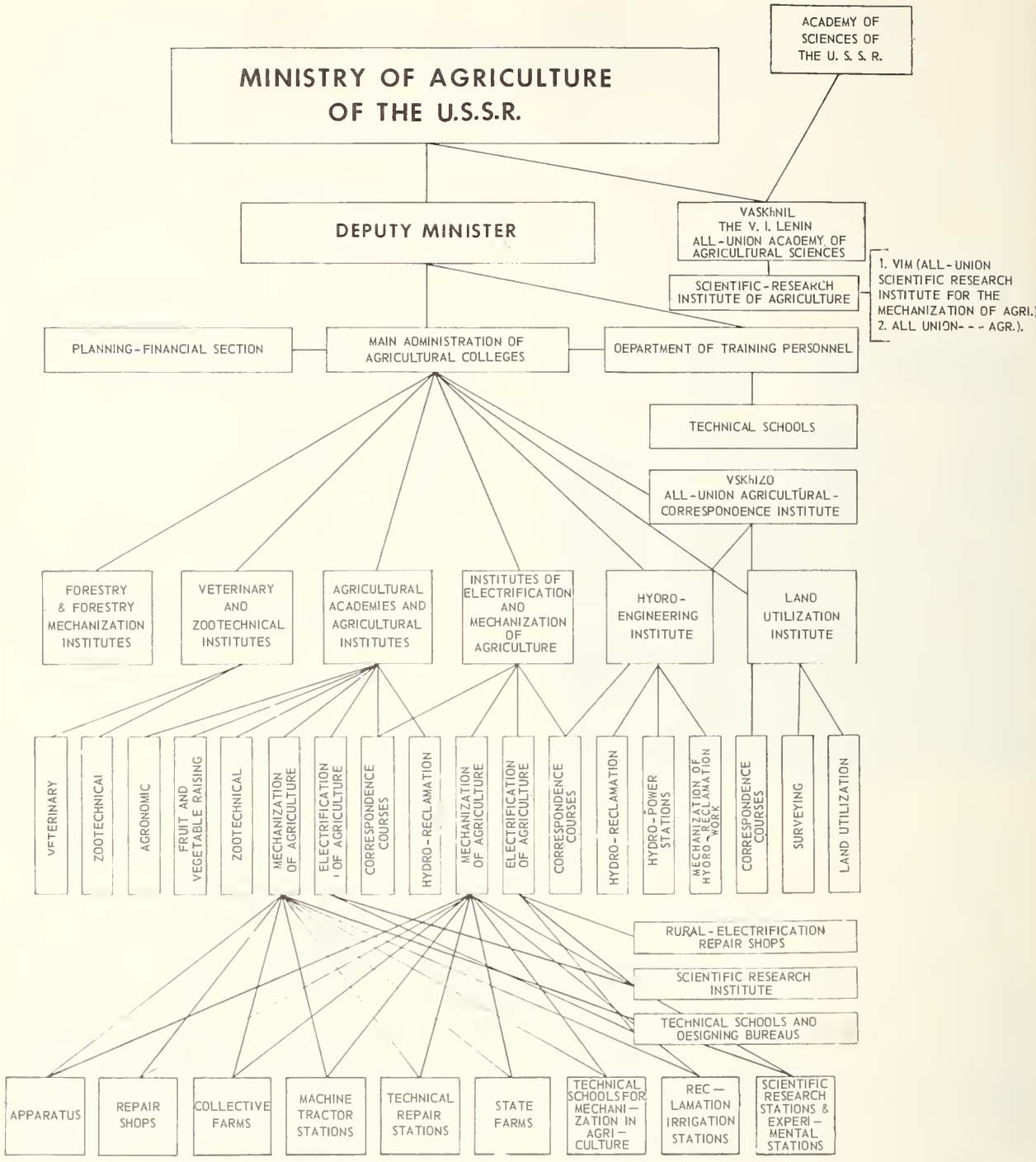
INSTITUTE OF RAILWAY TRANSPORTATION
INSTITUTE OF OCEAN TRANSPORTATION
INSTITUTE OF WATER TRANSPORT ENGINEERING
NAUTICAL SCHOOLS
ALL-UNION SCIENTIFIC RESEARCH INSTITUTE OF AGRICULTURE MACHINERY VISKhOM
AUTOMOBILE & TRACTOR SCIENTIFIC RESEARCH INSTITUTE (NATI)
AUTOMOBILE & AUTOMOBILE ENGINE SCIENTIFIC RESEARCH INSTITUTE (NAMI)
TECHNOLOGY OF AUTOMOBILE TRANSPORT PRODUCTION
SCIENTIFIC RESEARCH INSTITUTE OF AGRICULTURAL MACHINE BUILDING TECHNOLOGY

CHART 1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PLANNING-FINANCIAL SECTION
MAIN ADMINISTRATION OF AGRICULTURAL COLLEGES
DEPARTMENT OF TRAINING PERSONNEL
TECHNICAL SCHOOLS
VSKhIZO ALL-UNION AGRICULTURAL-CORRESPONDENCE INSTITUTE
FORESTRY & FORESTRY MECHANIZATION INSTITUTES
VETERINARY AND ZOOTECHNICAL INSTITUTES
AGRICULTURAL ACADEMIES AND AGRICULTURAL INSTITUTES
INSTITUTES OF ELECTRIFICATION AND MECHANIZATION OF AGRICULTURE
HYDRO-ENGINEERING INSTITUTE
LAND UTILIZATION INSTITUTE
VETERINARY
ZOOTECHNICAL
AGRONOMIC
FRUIT AND VEGETABLE RAISING
ZOOTECHNICAL
MECHANIZATION OF AGRICULTURE
ELECTRIFICATION OF AGRICULTURE
CORRESPONDENCE COURSES
HYDRO-RECLAMATION
MECHANIZATION OF AGRICULTURE
ELECTRIFICATION OF AGRICULTURE
CORRESPONDENCE COURSES
HYDRO-RECLAMATION
HYDRO-POWER STATIONS
MECHANIZATION OF HYDRO-RECLAMATION WORK
CORRESPONDENCE COURSES
SURVEYING
LAND UTILIZATION
RURAL-ELECTRIFICATION REPAIR SHOPS
SCIENTIFIC RESEARCH INSTITUTE
TECHNICAL SCHOOLS AND DESIGNING BUREAUS
APPARATUS
REPAIR SHOPS
COLLECTIVE FARMS
MACHINE TRACTOR STATIONS
TECHNICAL REPAIR STATIONS
STATE FARMS
TECHNICAL SCHOOLS FOR MECHANIZATION IN AGRICULTURE
REC-LAMATION IRRIGATION STATIONS
SCIENTIFIC RESEARCH STATIONS & EXPERIMENTAL STATIONS

CHART 2

Also under the Ministry is the All-Union Academy of Agricultural Sciences, under which are 35 All-Union Agricultural Institutes. Examples:

(1) All-Union Farm Mechanization and Electrification Institute in Moscow, and 6 other similar institutes.

(2) All-Union Institute for Farm Mechanization and Electrification, Rostov-on-Don.

(3) All-Union Cotton Institute, Tashkent.

(4) All-Union Drainage and Amelioration Institute, Minsk.

(5) All-Union Forestry Institute, Stalingrad.

(6) All-Union Irrigation Institute, Tashkent.

(7) All-Union Tobacco Institute.

(8) All-Union Rice Institute, Krasnodar.

(9) All-Union Corn Institute.

(10) All-Union Plant Breeding Institute (national seed bank, over 21,000 varieties).

(11) Kuban Research Institute for Tractor and Farm Machine Testing, Krasnodar.

Council of Ministers

The Council of Ministers, which operates directly under supervision of the Presidium, has 25 members; 7 of the 25 are All-Union. Ministries of top priority, such as heavy industry, are the most tightly centralized and controlled. Lines of control run directly to the top.

Each ministry has a so-called collegium of high officials who are advisory but who cannot interfere with the ministry's absolute power of decision within the overall plan.

In addition, most ministries have advisory councils, made up of 40 to 70 members. The Ministry of Agriculture has a Scientific Advisory Council of approximately 60 members chosen from high officials in the Ministry, directors of tractor and farm implement factories, outstanding engineers, and other technically knowledgeable people in agriculture.

Apparently all major questions of planning, research, and production are brought before the Council of the Ministry, which meets periodically for study and recommendations.

Recommendations of the Council are made to the Ministry, which carries its recommendations to GOSPLAN, from which recommendations in turn go to the Presidium and elsewhere, as outlined in the charts.

Each ministry is divided into various sections, such as Finance, Planning, Research, and Production.

The Soviet administrative organization has controls, and although there is undoubtedly private expression of suggestions or discontent, public expression is apparently unthinkable without prior clearance with Party authorities.

In many matters, the Soviet administrative setup turns for significant controls to other places such as: (1) Communist Party, (2) Secret Police, (3) State Planning Commission, (4) Ministry of Finance, (5) Ministry of State, (6) Legal controls, and (7) Personnel controls.

Although central control is very strict, many people in the outlying Republics, who are responsible to the Ministry of Agriculture, are on the payroll of the Republic or are paid by some local body.

We asked the question, "What is the budget of the Ministry of Agriculture?" One of the key officials of the Ministry frankly said, "I have no idea." Further, when we asked about how many people are employed by the Ministry of Agriculture, the reply was, "About 1,000."

Each Republic has a Scientific Council, and each Republic finances most of its own research. The All-Union Research Institutes are exceptions to the "decentralized" plan for research support. The details for planning and financing research were not clearly spelled out.

In our first conference with the Ministry (Aug. 22), we were told that several organizations were interested in agricultural research—The Bureau of Construction (Tractors and Machines); the Bureau of Economics; Council for National Economy (new products and their processing); Agricultural Academy of Science; and the Ministry of Agriculture. The Ministry of Agriculture is primarily concerned with the application of research findings in agricultural production operations.

At a later conference, the construction bureaus were described as "being responsible" to the Councils of National Economy. There are local councils in the different government republics—there may be several councils in one republic. For example, the Russian Soviet Federated Socialist Republic has more than 50 councils. Some small republics have only one Council of National Economy. The construction bureaus may be organized either separate from factories or within factories. Those in the factories are said to operate quite independently. Any construction bureau can cooperate with one or more factories.

There seems to be an interlocking check-and-balance on administration of programs. For example, the director of a Machine Testing Station outside Kiev said that he reports to the U.S.S.R. Ministry of Agriculture but works with the Ukraine Ministry of Agriculture.

The director of the Ukraine Institute of Farm Mechanization and Electrification said he is responsible to the Ukraine Academy of Agricultural Science and the Academy is responsible to the Ministry of Agriculture of the Ukraine, which in turn is responsible to the Ministry of Agriculture of the U.S.S.R.; yet the basic design work for this institute is done at the Bureau of Construction in Moscow, which is directly under GOSPLAN.

GOSPLAN

The State Planning Commission (known as GOSPLAN) is the overall planning body for the U.S.S.R.

Before 1948 and since 1951, it has held the overall responsibility for preparing and checking the progress of national planning.

GOSPLAN pervades the entire government structure, and each Union Republic has its own GOSPLAN organization. It is significant that there are planning committees in all regions, districts, and important towns and cities, as well as planning groups in every ministry and in all agencies and business enterprises responsible to it.

GOSPLAN is divided into about 25 sections, one of which controls all planning and execution of plans pertaining to automobiles, tractors, and farm equipment. G. S. Khlamov, chief of this GOSPLAN section, headed the U.S.S.R. Farm Mechanization Exchange Group that visited the U.S.A. in the summer of 1958. Some 20 years ago, he worked about 1-1/2 years for a motor company in the United States. He understands English well and speaks it fairly well.

OWNERSHIP AND USE OF FARM EQUIPMENT

As mechanization of agriculture increased in importance in Soviet planning, it was necessary to devise a way to apply this technology. Who would own the equipment? Who would operate it? How would it be maintained and kept in repair?

Since no land was privately owned and it was impossible for individual farmers to own and maintain tractors and other equipment, a system within the framework of a universally socialized agriculture had to be devised. Farms were being collectivized throughout the U.S.S.R.

So, in 1928, the first so-called Machine Tractor Station was set up. The MTS owned the equipment in the name of the state; and each strategically located station allocated the equipment to the various collective farms in its immediate vicinity.

Repair facilities were installed. A program to train maintenance personnel was established at institutes set up for this specific purpose. The idea and organization spread, until by 1957 more than 8,000 Machine Tractor Stations were in operation.

The system multiplied many problems. Management of the collective farms was separate from the centrally-owned tractors and equipment. We were told, however, that the equipment was usually field-operated by residents and employees of the farms. There was contradiction on this point.

The MTS built up great power, kept detailed records, and virtually spelled life or death to a farm enterprise because the farm was subservient to the allocation of equipment.

The MTS not only furnished the equipment, but was responsible for technical personnel, major repairs, supply of lubricants and fuel, and supervision of work accomplished with equipment. By 1957, we were told, these stations employed more than 2 million tractor drivers, mechanics, and other semitechnical people. By 1957, it was estimated that more than 277,000 specialists in all phases of agriculture, including tractor and equipment operators, were functioning.

By officials' own admissions, the divided responsibility between the MTS's and the managers of collective farms often caused delays, duplication, misunderstanding, and general inefficiency.

In 1958, following a lengthy speech by Khrushchev, it was decreed that the MTS's would be replaced by Repair Technical Stations. Ownership of tractors and equipment was to be taken over by the farms, and necessary services would be handled by the RTS's.

We were told that impartial committees were set up to appraise the equipment and to help determine the prices that should be paid by the farms for the used equipment being transferred from the state-owned MTS's to the state-controlled collective farms.

At the time of our visit, much of this transfer of ownership had been carried out.

State farms have always had jurisdiction over the equipment they use. Therefore, with the abolition of the MTS's, collective farms may gradually approach a par with state farms, so far as equipment is concerned.

Repair Technical Stations

Whereas the MTS serviced about 10 or more collective farms, one RTS now services the farms previously covered by 3, 4, or more MTS's.

The RTS assembles orders for tractors and equipment from the farms and then forwards requests to the planning agencies so that production schedules can be worked out for delivery of equipment on a quarterly basis.

Collective and state farms place their requests with the Repair Technical Station for equipment they want to purchase during the year and take delivery each quarter. These requests are submitted to the Ministry of Agriculture. The Ministry assembles them, and they are discussed by the Scientific Council of Agriculture.

The Scientific Council of Agriculture then takes its recommendations to GOSPLAN, the overall planning and control group.

GOSPLAN fits the recommendations into the general overall economy and designates which factories will produce what and how many.

The RTS not only distributes the manufactured equipment to the farms, but also does the major repair work on all equipment, especially tractors, and in most cases supplies fuel, oil, grease,

fertilizers, pesticides and other supplies, and important technical and supervisory services attendant to the farm equipment industry. It also displays equipment and holds demonstrations, distributes literature, and performs other general services and educational functions relating to the mechanization of agriculture.

The RTS has its own staff of workers, technicians, engineers, and other necessary help. Each year it makes agreements with the farms it serves and by which it is paid for services performed.

The RTS still has rather rigid control over operation of tractors. For example, daily reports on amount of work done and fuel consumed are mandatory.

No equipment can be traded in, although a farm can sell used equipment to another farm if a buyer can be found.

Nearly every collective and state farm has fairly good machine shop and repair facilities; but for major repair jobs, tractors and equipment are taken to the RTS's.

It is a rather determined practice to have every tractor brought to the RTS for a complete overhaul once every 2 years, but apparently the farms have some choice as to when they bring them in and what repairs are made. The facilities we saw at the RTS's were good.

When the RTS repairs an engine or replaces one in a tractor, the farm is charged the cost of the repairs plus rental of equipment used while repairs are in progress. We were told that the average cost of rebuilding a tractor is about 20 percent of the original cost.

During the peak season the RTS, tractor operators, and combine operators work "around the clock." The operators work in two shifts, 10 hours each.

Drivers and operators are trained in trade schools. A "Review Commission" considers both practical tests and written tests prior to issuing operators' licenses. Licenses are issued in two grades, 1st and 2d, and operators are relicensed each year.

Our group visited several RTS's including one at Kharkov and another near Krasnodar.

The Kharkov RTS provides service to 19 farms and 50 other enterprises, in an area approximately 50 kilometers in radius. It has about 40 personnel, including 20 engineers and other technical men, and provides service for more than 200 tractors and 100 combines. In addition, about 60 machine operators work on the farms and cooperate in repair programs with the RTS. Two-way radios connecting the RTS and the tractor and combine brigade camps, together with mobile repair shops, help to keep the machines operating during rush times.

A schedule of repair and maintenance of tractors and machines is set up by agreement with the collective and state farms, the major overhauls taking place during the autumn and winter. The machine operators help the repair staff. Complete disassembly and repair is given a tractor at about 4,500 hectares (approximately 10,000 hours).

The Kharkov RTS adds about 12.8 percent to the "factory" price of the machines as a handling charge. It accepts no trade-ins. The RTS sends out forms on which orders are placed for machines and tractors. Orders for 1959 tractors and combines had been placed prior to our visit on September 5, 1958. This RTS does not conduct an educational program. Repair kits and subunit parts (such as fuel pumps, transmissions, and starting engines) are available for sale or temporary replacement while damaged units are being repaired. The RTS has special machines for rent to prevent crop disasters.

This RTS is self supporting, with the exception of three state-paid specialists—the chief inspector, inspector, and agronomist. The agronomist is concerned with diseases, pest control, and the like, whereas the inspectors are concerned with the proper use and maintenance of all tractors and machines. They give advice and recommendations regarding care and maintenance. If no attention is given to "advice" the inspector has the authority to suspend the operator's license. He has authority to collect damage costs from the salary of the operator if the damage is due to negligence or misuse. Collection is arranged through the bookkeeper for the farm. The judgment of the inspector is based on "well-known" rules of operation. An example is the rule for "thorough inspection" after 1,500 hours of operation. If the rule is not complied with, there is first a warning and then some action by the inspector. The record keeper for the brigade makes daily reports on the kinds of operation and the machines used with each tractor.

The new parts building of the Kharkov RTS was relatively small. They had a nice machine shop, a short assembly line for the repaired tractors, engine dynamometers, fuel injection unit repair and test section, sheds for new machines, fuel delivery trucks, repair trucks, and a large area surrounding the buildings.

The Krasnodar RTS is similar to but larger than the Kharkov RTS. It has responsibility for 450 tractors, 400 trucks, and 150 grain combines. There are 180 workers plus 31 engineers and other technicians.

Machine Test Stations

Machine Test Stations (MST's), as their name implies, were organized to evaluate the prototype machines developed by the various research and machine building institutes and construction bureaus. Our group visited several MTS's and found the time both interesting and profitable. We were told that 23 MTS's are now functioning and 3 more are being organized.

The testing season is from April to December. The usual practice is to test two machines of each model. The factory representative may be present and, if he disagrees with the findings, he may write a report which is considered by the Scientific Council of the Agricultural Ministry. Results of the tests are published in the Agricultural Ministry magazine, "Tractors and Agricultural Machines." We were told that in the near future bulletins will be published showing specifications, identification of the manufacturing plant, and test results.

The "state" standards for testing machines and tractors are prepared by many scientists from the different educational and research institutes and approved by the Scientific Council. Reports on tests, covering quality of work, labor required, reliability, ease of handling, safety, amount of metal used in construction, and the like, are made to the Council.

The Kuban Institute for Testing Tractors and Agricultural Machinery, near Krasnodar, is primarily a research institute concerned with methods and equipment for testing. Its employees claim that it is the only institute of its kind in the U.S.S.R. Special attention is given to basic requirements for machines and tractors and to methods for evaluating equipment used in new mechanized processes for agricultural production. This institute has 184 employees, including 30 engineers, 10 agronomists, and 4 economists.

Experimental equipment at the Kuban Institute included strain gage instruments, recording draft-type dynamometers, and an electric dynamometer for testing tractor engines. Experimental machines included a new crawler tractor, a mounted duckfoot cultivator, and a combine modified for castor bean harvesting.

The institute was also testing some foreign machines. We observed a Sheppard diesel tractor (made in the U.S.A.) and two Fiat tractors (made in Italy), and the director indicated that two A. O. Smith glasslined silos (U.S.A.) were under test.

Figure 3.--One of several experimental corn "snapper-cutters" observed under test at the Ukraine Machine Test Station.

Figure 4.--A potato harvester under test near Barnaul in Siberia.

COLLECTIVE AND STATE FARMS

Organization of Collective Farms

A collective farm is called a "voluntary association of peasant farmers." The collective farm members "elect" or sustain a chairman, who may be selected from outside the membership. They also endorse a board selected from the membership. The number of board members varies among farms.

One collective farm we visited has a board of 11 and a revision committee of 7. Another has a board of 9 and a revision committee of 5. The chairman and the board members are elected for a term of 1 or 2 years, but any of them can be ousted by decision of a general meeting at any time.

Each collective farm holds monthly management conferences, division meetings, and an annual meeting (which sometimes lasts all day).

The chairman, along with the collective farm board, draws up the program for the year. He must report at the annual meeting.

Each collective farm has a District Executive Committee made up of specialists who are employees of the Republic. This committee inspects and supervises the collective farm operations, sets quotas, approves programs, and sees that plans are carried out on the farms. The Communist Party organization also supervises.

It is part of the function of the Ministry of Agriculture of the Republic (within the framework laid down by the U.S.S.R. Ministry of Agriculture) to oversee the work of its regional and district committees. The budget is approved by the Ministry of Agriculture of the Republic.

Detailed records are kept of work performed, and each worker shares in the income of the common enterprise.

We were told that each month the collective farmers get an advance on future income. At the end of the year, when all information is in and recorded, a final distribution of income is made to each member on the basis of workday units and work performance norms.

Each collective farm family is allowed to use a small plot of land (usually not exceeding 1 acre) for a garden, fruit trees, raising chickens, a cow, a few pigs, and similar enterprises.

We learned of various schemes and efforts to get the farmers to spend less time on their own plots and more effort on the large collective enterprises. For example, the collective farm sometimes sells the farmer milk for one-half or one-third the price received for milk delivered to the combine.

Outstanding workers who have filled many times their quotas or their daily norms are rewarded for their efforts, and they are held up as ideals to work toward. People are paid incentives for production over quotas or for their efforts to reach the records set by the people who have received awards.

Officials claim that what is inspiring to the people is that these innovators or front-rank workers enjoy fame and honor and become distinguished people regardless of their origin—whether they have been peasants, executives, or government workers, or leaders in the Communist Party.

Here in essence is what we were told at the Lenin Collective Farm near Zaporozhe:

At the annual meeting, a board of nine people is elected, also a separate revision board of five people. They determine the amount of work that is to be considered a workday and the days on which workers are paid.

For technical advice, a Regional Agricultural Executive Committee of 18 is elected. Each oblast nominates one candidate for the executive committee. The name is finally placed on the ballot by the electoral committee. When we inquired further, we were told that there are really two elections. One is the election of the electoral committee by open ballot. Most of these people are from trade unions. Then there is the final vote on the candidate by secret ballot.

This committee meets at least once a year. If a worker is dissatisfied with his pay for workday units, he sees this committee, which sets quotas and workday units.

The committee elects its own chairman, and its decisions must be approved by a general meeting of the able-bodied people who have a right to vote. At the annual meeting, the general body can disapprove and change the workday units. Work units may be changed from year to year as output varies. Differences in work units between collective farms are not great.

The committee has a number of divisions such as education, public health, and agriculture (Regional Agricultural Board).

When some emergency arises that is not covered by the program for the year (such as costs or revision of the building program), a meeting is called.

We were told that if a state official finds something he thinks is not right on the farm, he can make recommendations for consideration by the chairman and the board, but the final decision rests with the farmers at their general assembly.

At the Telman Collective Farm, Minsk Region, the chairman's salary is based on 120 workdays per month. This is fixed at a general meeting and amounts to 2,500 rubles per month, plus 1 percent of the farm's gross income. The salaries of the agronomist and the agricultural engineer are 80 percent of that of the chairman (or 96 workdays), plus 1/2 of 1 percent of the gross income.

A norm is set on this farm, but a good worker can fill two or three norms in 1 day. The norms, as recommended by a committee, must be approved at a general meeting on the farm. A quorum consists of three-quarters of the able-bodied workers.

Rather than altering the base pay of tractor drivers and other skilled workers the number of workday credits per actual day worked is increased, possibly up to 3 workday units per day.

This farm has a Regional Executive Committee supervised by employees of the Republic's Ministry of Agriculture. This committee has several divisions, including education and agriculture. Probably some committee members are elected, but most are staff people; and they supervise the details of operation of the collective farm.

Organization of State Farms

As the name indicates, state farms are outright state enterprises. All farmworkers, from the director to the field workers, are employees of the state.

State farms often operate alongside collective farms. Virtually all "new lands" agricultural developments are state farms, and more and more farmland is coming under state farm operation. There are indications that government leaders would like all farms eventually to be state farms.

State farms are favored for electrification, mechanization, and other modernization. For example, we were told that 40 percent of the collective farms have electricity, whereas all state farms are electrified.

State farms are larger than collective farms. As stated earlier, the MTS's did not serve state farms, as each farm owned its own equipment, but now the RTS's serve state farms just as they do collective farms.

A state farm is responsible to the Regional Executive Committee of the Republic's Ministry of

Agriculture, which is under the supervision of the U.S.S.R. Ministry of Agriculture.

Each employee is paid wages and each family has the use of a small plot, somewhat similar to the system on collective farms.

Some state farms are general farms, but most are specialized, such as grain, dairy, and sugar beet farms.

There are trade unions for state farms for all the U.S.S.R. We asked whether it was necessary for a worker to belong and were told, "It is not compulsory but very convenient, and all do." There are no strikes.

Equipment on Collective and State Farms

Table 1 shows the size of operations of the farms we visited. Note that the smallest collective was only a little over 3,000 acres while the state farm "Altai" was over 100,000 acres. In 1956, somewhat less than 80,000 collectives had an average of about 4,000 acres in crops. In 1956, each of about 5,800 state farms had an average of more than 15,000 acres in crops. By plan the collectives are gradually diminishing in number as they are being merged into larger collectives or state farms.

Table 1.—Typical statistics from collective and state farms

Item	Telman Collective Farm, Minsk	Lenin Collective Farm, Zaporozhe	Grain State Farm, Krasnodar	Altai Milk State Farm, Barnaul	Trud Collective Farm, Topchikha	Rodina Collective Farm, Shipunovo
Area:						
Approximate total. . .acres	3,300	11,900	---	112,500	16,000	27,800
Farmable . . . . . do	2,800	9,200	---	66,700	12,600	21,000
Per worker . . . . . do	8	10	[1]39	---	35	35
Per tractor . . . . . do	317	775	400	470	---	785
Personnel:						
Total . . . . . number	950	2,180	---	7,000	700	---
Farmworkers. . . . do	347	928	[2]700	2,500	370	611
Crops:						
Corn silage . . . . .hectares	58	---	---	2,000	328	---
Potatoes . . . . . do	150	---	---	---	---	---
Wheat. . . . . do	[3]4,008	---	640	2,100	3,200	---
Machine Inventory:						
Tractors. . . . . number	9	12	98	135	---	27
Combines . . . . . do	3	6	60	100	---	20
Ensilage harvester do	1	2	---	---	---	---

[1]Based on an average of 1,000 workers.
[2]Regular workers, plus 600 to 700 seasonal.
[3]Includes rye, barley, and oats.

SCIENTIFIC ESTABLISHMENTS

Scientific establishments are divided into three groups:

(1) Academies, which are the highest scientific centers of the U.S.S.R. and the Union of the Republics, leading among them being the U.S.S.R. Academy of Science.

(2) Higher educational establishments, which are not only educational but research centers.

(3) Scientific and research establishments, maintained by the Ministries, Departments, Soviets, Working People's Deputies, and public organizations (the latter nearly always refers to the Communist Party).

The U.S.S.R. Academy of Science's primary function is to promote the general progress of theoretical and applied sciences, and it is directly subordinate to the Presidium. It is composed of honorary members and members of the Academy (academicians) who meet in general meetings. The Academy of Science elects a president for a term of 5 years.

Research establishments affiliated with the U.S.S.R. Academy of Science include 60 or more scientific institutes and 6 institute branches, plus numerous other scientific experiment stations, including observatories, botanical gardens, and the like.

There are academies of Medical Science, Arts, Construction and Architecture.

The Lenin Academy of Agricultural Sciences of the U.S.S.R. was founded in 1929 and is located in Moscow. It has the following sections:

(1) Agriculture

(2) Animal Husbandry

(3) Mechanization and Electrification of Agriculture

(4) Hydroengineering and Amelioration

(5) Forestry and Farm Forest Amelioration

(6) Organization of Agricultural Production

In addition to numerous institutes, there are individual memberships and corresponding memberships.

Scientific titles awarded include:

(1) Doctor of Science, the highest scientific degree in the U.S.S.R., is awarded to people over and beyond the Candidate of Technical Science (Master of Science) degree.

(2) Titles of Assistant Professor and Professor are conferred by higher educational institutions.

(3) Titles conferred by the scientific institutes are: Junior Scientific Worker, Senior Scientific Worker, and Professor.

(4) Titles in the academies are: Members, Academicians, and Corresponding Members.

Many scientific societies of the U.S.S.R. are closely connected with the U.S.S.R. Academy of Science and with other academies such as the Lenin Academy of Agricultural Sciences. For example, related to agriculture would be botanical, hydrological, entomological, soil science societies, and the like. We were told there is a special society for agricultural engineers. Two other organizations of interest to agricultural engineers are the Moscow Mathematical Society, founded in 1867, and the Scientific and Engineering Society.

Distinctions are conferred on outstanding scientists and engineers by the various union republics and the U.S.S.R., under such titles as "Honored Worker of Science," "Honored Worker of Science and Engineering," and "Hero of Socialist Labor."

We do not recall meeting anyone who had received the first two titles, but we did see collective farm chairmen and others who had conferred upon them the title "Hero of Socialist Labor."

RESEARCH IN FARM MECHANIZATION

As in the U.S.A., educational institutions do research as well as teaching. However, special attention should be given to some research institutes.

The All-Union Research Institute for Mechanization of Agriculture, Moscow (chart 3), deals mainly with the mechanization of field work. The institute has a total staff of 500 persons and 20 laboratories concerned with research related to design, development of prototypes, and design analysis of agricultural machines and tractors. It is also concerned with electrification mechanization of animal production operations.

The Research Institute for Repair and Use of Tractors and Machines, Minsk, is financed by the Ministry of Agriculture and operates as an experimental manufacturing plant, but studies work quotas and standards of what tractors should be able to do, depending on conditions in various localities. It devises machines to assist in the repair of tractors. Its research is coordinated with related work at 200 similar institutes, 42 centers, and 20 institutes on research. It reports findings to these institutes and publishes booklets on repairs, similar to booklets issued by private firms in the U.S.A. The Institute has a total staff of 342, including 42 engineers and other scientific workers.

The Ukraine Research Institute for Farm Mechanization and Electrification, Kiev, has a staff that is said to include 260 professional people working on problems encountered on collective and state farms. The research proposals, which appear to concentrate on application and design analysis, are presented to the Ukraine Academy of Agricultural Science as part of a total research program. Although some prototype machines are developed, the latter job is left mainly to the Machine Building Institutes.

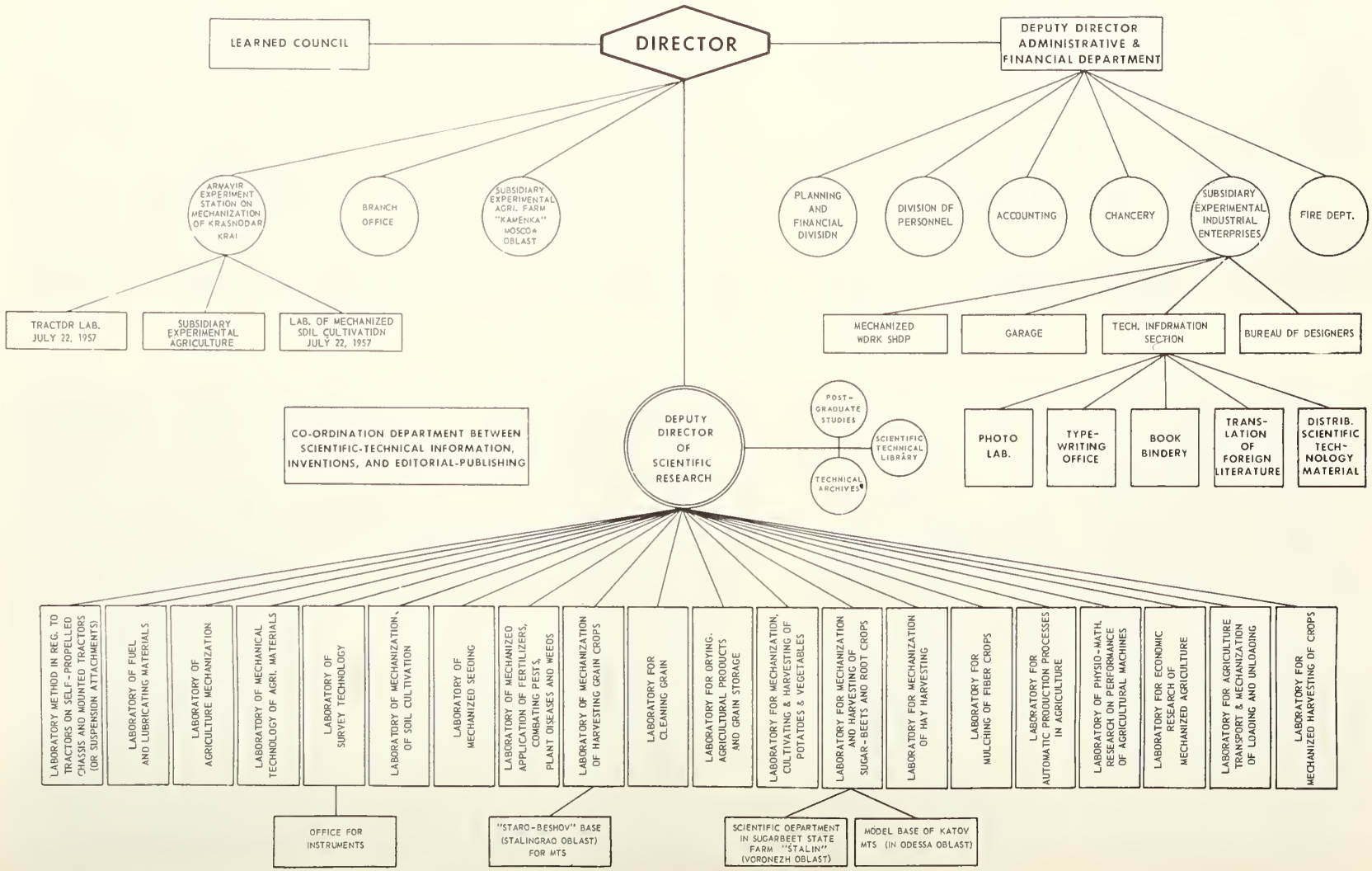
The All-Russia Research Institute for Mechanization and Electrification, near Rostov-on-Don, has a staff of 450 including 110 with higher education. Problems are concerned mainly with the technical management and repair of the tractor and machinery fleets used on the large farms. However, this Institute, the chief research and machine testing station for the Russian Soviet Federated Socialist Republic, had by far the most active projects pertaining to farmstead mechanization of any place we visited.

The U.S.S.R. Research Institute for Farm Machine Building, Moscow, is responsible to GOSPLAN, although it cooperates rather closely with the Institute of Farm Mechanization and Electrification. Whereas the Mechanization Institute is primarily interested in basic requirements of machines, the Machine Building Institute is directed more to machine design and research with elements of machines. This Institute cooperates with the machine construction bureaus in factories. It took the leadership in designing and developing prototype cotton and tea production machinery since there are no special construction bureaus for these machines.

FRAMEWORK OF ORGANIZATION OF VIM

(ALL-UNION SCIENTIFIC RESEARCH INSTITUTE FOR THE MECHANIZATION OF AGRICULTURE)

AT MAY 28, 1957



The total staff is about 700 of which approximately 50 percent have higher education. Ninety of the latter are women.

The Machine Building Institute had a special "measurements" laboratory employing 10 instrument designers. Indoor soil bins nearly 300 feet long were a part of the tillage laboratory. The stress-measurement laboratory was impressive because of its glass-enclosed instrument room, TV-type instrument consoles, and large testing floor.

The All-Union Research Institute on Rural Electrification, near Zaporozhe, had 25 engineers and other scientists working on applications of electricity to agriculture. The three divisions of their work were: Application of electricity to plant and crop production, power plants and electrical distribution systems, and high frequency applications in agriculture.

Figure 6.--Experimental single-row silage harvester with vertical cutting rolls. (The All-Russia Institute for Mechanization and Electrification, Rostov-on-Don.) (BN-8899)

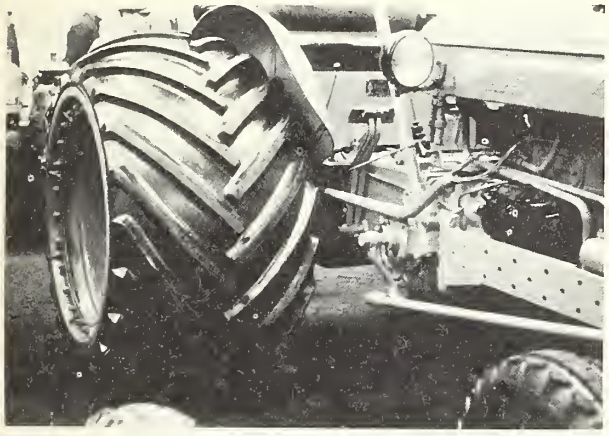


Figure 5.--Experimental tractor tire, 840 millimeters wide, inflated to approximately 1/2-atmosphere pressure. (The Research Institute for Repair and Use of Tractors and Machines, Minsk.) (BN-8898)

Figure 7.--Experimental storage of silage between stacks of straw. (The All-Russia Institute for Mechanization and Electrification, Rostov-on-Don.) (BN-8900)

EDUCATION FOR FARM MECHANIZATION

What kind of an education is provided for the people in the Soviet Union—a country where mechanization has virtually replaced the wooden plow in a few years? Where practically everyone is literate? Where scientific work is attracting the attention of the outside world? In the last 10 years, mechanization of agriculture has produced 170,000 corn pickers and silage combines, 30,000 sugar beet harvesters, 500,000 combines, and 330,000 windrowers. Field operations such as plowing, seeding, cultivating, and harvesting are almost entirely mechanized. There are still many horses and a few oxen, but they are used mainly for transportation operations.

Educational Facilities

The Ministry of Higher Education has administrative responsibility for the teaching programs of the Institutes for Farm Mechanization and Electrification. Their research programs are apparently administered jointly by the Ministry of Agriculture and the Agricultural Academy of Science. Chart 4 gives the general layout of educational administration in the U.S.S.R.

The director of an Institute for Mechanization of Agriculture is responsible to the Ministry of Agriculture of the U.S.S.R. or to the Minister of Agriculture of the Republic in which the institute is

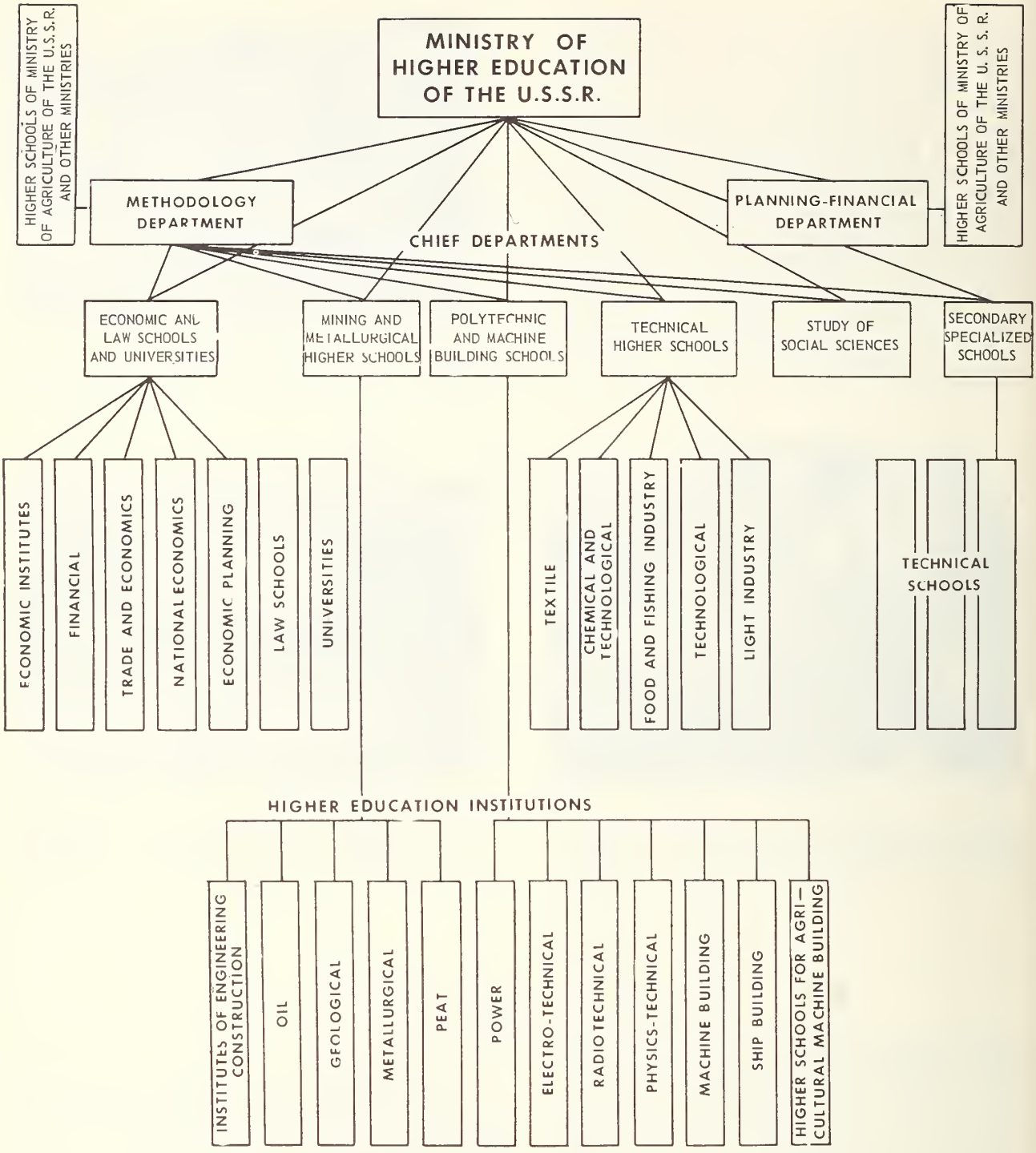

MINISTRY OF HIGHER EDUCATION OF THE U.S.S.R.
HIGHER SCHOOLS OF MINISTRY OF AGRICULTURE OF THE U.S.S.R. AND OTHER MINISTRIES
METHODOLOGY DEPARTMENT
CHIEF DEPARTMENTS
PLANNING-FINANCIAL DEPARTMENT
HIGHER SCHOOLS OF MINISTRY OF AGRICULTURE OF THE U.S.S.R. AND OTHER MINISTRIES
ECONOMIC AND LAW SCHOOLS AND UNIVERSITIES
MINING AND METALLURGICAL HIGHER SCHOOLS
POLYTECHNIC AND MACHINE BUILDING SCHOOLS
TECHNICAL HIGHER SCHOOLS
STUDY OF SOCIAL SCIENCES
SECONDARY SPECIALIZED SCHOOLS
ECONOMIC INSTITUTES
FINANCIAL
TRADE AND ECONOMICS
NATIONAL ECONOMICS
ECONOMIC PLANNING
LAW SCHOOLS
UNIVERSITIES
TEXTILE
CHEMICAL AND TECHNOLOGICAL
FOOD AND FISHING INDUSTRY
TECHNOLOGICAL
LIGHT INDUSTRY
TECHNICAL SCHOOLS
HIGHER EDUCATION INSTITUTIONS
INSTITUTES OF ENGINEERING CONSTRUCTION
OIL
GEOLOGICAL
METALLURGICAL
PEAT
POWER
ELECTRO-TECHNICAL
RADIOTECHNICAL
PHYSICS-TECHNICAL
MACHINE BUILDING
SHIP BUILDING
HIGHER SCHOOLS FOR AGRI-CULTURAL MACHINE BUILDING

CHART 4

Figure 8.--Experimental conveyor designed to transport silage from the between-stacks storage shown in figure 7. (BN-8901)

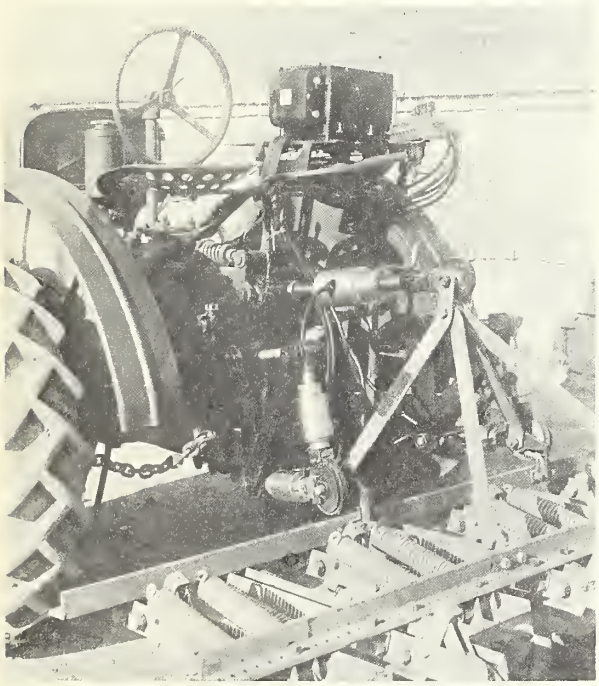


Figure 9.--A well-instrumented tractor mounting for measuring the horizontal, vertical, and side reactions exerted by three-point mounted implements. (The Research Institute for Farm Machine Building, Moscow.) (BN-8902)

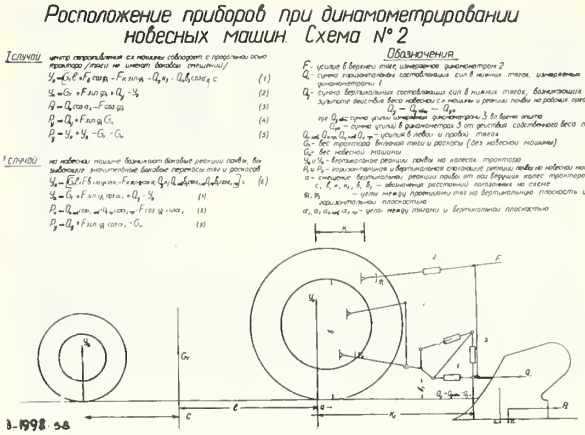


Figure 10.--Schematic diagram of the apparatus shown in figure 9. (BN-8903)

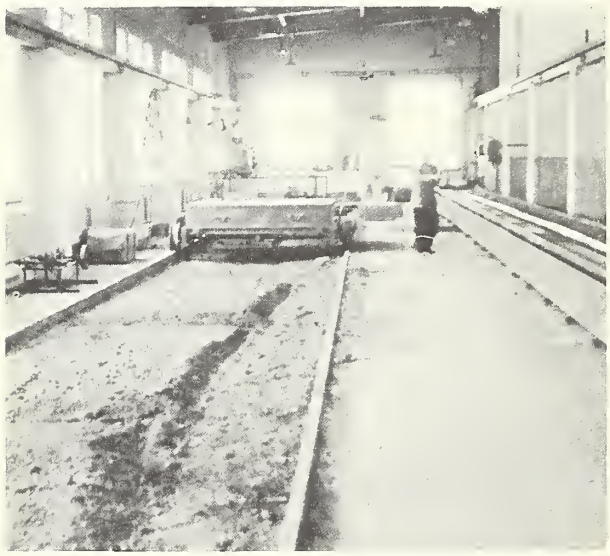


Figure 11.--Left, Soil bin for experimental tests of tillage implements. Right, a long track for checking the performance of seed planters. (The Research Institute for Farm Machine Building, Moscow.) (BN-8904)

located. The director receives about four times the income of a beginning engineer. There may be several professors in a department of the institute. The head of the department is the one who occupies the chair, and he may or may not be a professor. Often an associate professor is the head of the department, and he is responsible for the administration of the teaching and research program.

One is impressed by the large number of centers of higher education and research. In Moscow there are 103 institutes; in Minsk, 11; in Kiev, 13; in Kharkov, 57; in Leningrad, 52; in addition, each area has a university. The U.S.S.R. has 735 institutes, and 33 universities (which compare to our college and universities), and 3,500 technical or trade schools.

Of the 200 million people living in the U.S.S.R., 2 million are students in technical institutes and universities. Another 2 million are in technical schools (trade and vocational study). The institutes train students for special fields such as radio, steel, milk, meat, languages, machine tools, metallurgy, electronics, and agricultural engineering.

Figure 12.--Experimental plow equipped with glass moldboard. (The Research Institute for Farm Building, Moscow.) (BN-8905)

The U.S.S.R. graduated 71,000 engineers in 1956, whereas the U.S.A. graduated 26,000. In the U.S.A. there are 1,800 colleges and universities with 3,500,000 students and 196,000 full-time college teachers operating on a total budget of about $3 billion.

Listed below are the educational and research centers we visited during our tour of Russia:

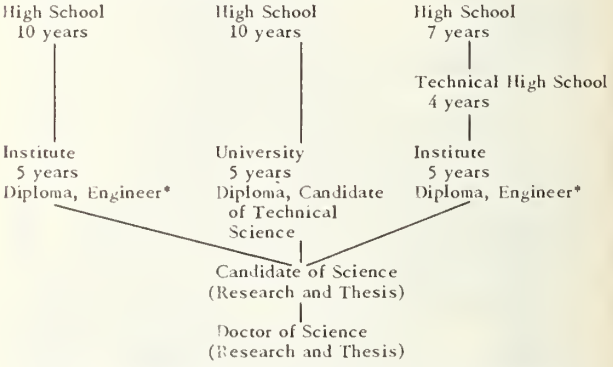
The Research Institute of Farm Mechanization, Moscow.
The Institute of Farm Mechanization and Electrification, Moscow.
The Institute of Technology and Repair, Moscow.
The Byelorussian Institute of Mechanization and Electrification of Agriculture, Minsk.
Ukraine National Research Institute for Farm Mechanization and Electrification, Kiev.
Ukraine Academy of Agricultural Sciences, Kiev.
All-Union Research Institute of Farm Electrification, Zaporozhe.
All-Russia Institute for Farm Mechanization, Rostov-on-Don.
Kuban Research Institute for Tractor and Machine Testing, Krasnodar.
Milk State Farm School, Altai, near Barnaul in Siberia.
The Institute of Constructors Bureau for Farm Machine Testing (GOSPLAN), Moscow.
University of Moscow, Moscow.

Educational Pattern

Training in the U.S.S.R. begins in either 7-year or 10-year schools; the former are more common in the rural areas and the latter in the cities. A student with the necessary grades and interests can go from the 7-year school to the 4-year technical high school. If he stops his training at this point, he is a technician. Under special programs, the qualified graduate of the technical high school can go to an institute and receive a diploma, such as Diploma Engineer. The more common method is to graduate from the 10-year school and attend an institute for 5 years after which the student receives a degree, such as Diploma Engineer. With the necessary qualifications the student can go from the 10-year school to the university, which requires from 5 to 5-1/2 years to receive a degree, such as Diploma Mathematics. After receiving the Diploma, which is equivalent to the Bachelor of Science, students may earn the Candidate of Technical Science degree, which is equivalent to our Master of Science, and the Doctor of Technical Science degree, roughly equivalent to our Ph. D. degree. Degrees are given in Physical Science, Arts, or Technical Science, depending on the field. Advanced study includes mainly research work with few or no additional courses. In addition to the plans mentioned above, the degree Diploma Engineer can be obtained by correspondence study, as described on page 19.

The 10-year school we visited had 42 teachers for 652 students.

The various educational programs may be summarized as follows:



By a recent edict of Khrushchev, most students are to obtain 2 years of practical experience before going on to higher education.

Agricultural Engineering

The U.S.S.R. has 7 institutes for the Mechanization and Electrification of Agriculture devoted to training agricultural engineers, and 50 other institutes have a faculty (department) of Agricultural Engineering. Students enter these institutes after 10-year school or 7-year school plus technical high school. Each institute has from 1,000 to 2,000 students.

The educational programs for Agricultural Engineering are operated under the Ministry of Agriculture and must be approved by the Ministry of

*After completing study course each student must present a technical thesis to a state commission which must approve the granting of the degree "Diploma Engineer." Some Institutes offer graduate work leading to the Candidate and Doctor degrees.

Higher Education. An institute for the Mechanization and Electrification of Agriculture may include departments of Applied Mechanics, Thermal Technology, Mathematics, Design, Tractor and Automobile, Harvesting Machinery, Tillage Machinery, Economics, Electrical Engineering, Mechanization of Animal Husbandry, Agronomy, and Electricity in Agriculture. The departmental structure varies from one institute to another but is based on subjects very similar to those in the U.S.A.

Institute Student

How does one become a student in one of the institutions of higher learning, particularly in an institute for engineering such as Agricultural Engineering? If a person is 18 years of age and under 35 years and has graduated from a 10-year school or technical high school he can apply for admission. Competitive examinations are given by the institute. About 25 percent of those examined are admitted. Of those admitted, 95 percent complete the 5-year program of 10 months of study per year, 6 days per week.

Oral and written examinations are given during a 20- to 25-day period twice a year. If a student fails a subject, he does not have to repeat the work if he can pass another examination. If he fails more than one course, he must repeat all courses.

The institute provides stipends for 90 to 95 percent of the students. The stipend for the first year is 300 rubles per month and for the fifth year, 480 rubles per month with 20 percent extra added for those with high grades. The official (and unrealistic) exchange rate is 25 cents per ruble. However, the tourist exchange rate is 10 cents per ruble. The latter rate is more in line with prices paid for items in the U.S.A. Married students receive the same stipend, but their attendance is not encouraged. Most of the stipend is required for room (30 rubles per month) and board (250 rubles per month and up). Tuition, supplies, and books are furnished.

As an additional stimulus for studying, students who receive superior grades get first choice of jobs available on graduation. Pictures of students who receive superior grades are displayed in the entrances of the teaching institutes.

The student studies general and basic courses the first 2 years, and specializes in the major field the last 3 years. He spends 50 percent of his time in laboratory and practical work, 25 percent in lecture, and 25 percent in working on project and research for the thesis. He devotes from 28 to 36 hours per week or 800 to 1,000 hours per year during the first 4 years to the studies. He must write a suitable thesis to receive a Diploma Engineer degree. Engineering students in the U.S.S.R. spend approximately the same time as students in the U.S.A. in mathematics, mechanics, strength of materials, kinematics, thermodynamics, and more time in machine design, tractor design, repair and practical applications, and less or very little time in humanities, languages, and natural science at the institute level.

A typical program of study for an agricultural engineering student at an institute is as follows:

	Hours
Mathematics (same as at University)	340
Strength of materials	190
Kinematics	120
Parts of machines	200
Mechanics	180
Hydraulics	70
Electrical engineering	130
Technology of wood and metals	390
Allowances and measurements	90
Additional lecture on above subjects	40
Laboratory	40
Thesis	10
Fuel and grease, including laboratory	50
Thermodynamics and steam	150
Agricultural subjects covering soils, plant breeding and crops, etc.	160
Agricultural machinery	250
Tractors and automobiles	280
Mechanization of animal husbandry	110
Repair of agricultural machinery and tractors	180
Application of machinery and tractors	180
Economical organization and use of machinery	150
Electrical drive and application of electricity	100
Total class time	3,410

To this must be added time spent on practical work in the field, and 4 months for preparing a diploma engineer thesis on a subject selected from a list provided by the faculty.

Another program in agricultural engineering included a total of 4,670 hours not including the final examination, of which 2,380 hours were for lectures, 820 hours for laboratories in the institute, 1,250 hours for practical work in the field, and 130 hours for seminar, working on an assigned problem.

All students have the right to apply for advanced work leading to the Candidate of Technical Science degree. Only the best students are permitted to go directly to work on the Candidate degree while others may be permitted to pursue the degree after passing an examination. In an exceptional case, because of outstanding research accomplishments, a student may work toward the Doctor of Technical Science degree without first obtaining the Candidate degree. Students may work on an acceptable and approved thesis while on the job after graduation. Advanced degrees are awarded by the

Scientific Council of the U.S.S.R. Military training is not compulsory for students attending the universities and institutes. If a graduate of the Institute of Agricultural Mechanization wants to do design work and has the ability, he can go into design in a separate machinery institute after he is out of school, or he can transfer while in school if he receives the approval of the two directors. Usually this is not done.

From 4,000 to 5,000 students, of which 85 to 90 percent are men, graduate each year from the 5-year program in Agricultural Engineering. This program is very similar to the 4-year courses in the U.S.A. except that it provides more practical training. More practical training is required because the students do not have the opportunity to develop mechanical skills in previous years. In comparison, most Agricultural Engineering curricula in the U.S.A. have broadening courses in the humanities that are not included in the U.S.S.R. curricula. In Russia, principles and practices of government and languages are taught before the institute and university level. Graduates of the Institutes for the Mechanization and Electrification of Agriculture go into occupations for the "exploitation" of tractors and machinery. Twenty percent of the graduates go into research and the remainder into production phases.

The reasons given for so many students in Agricultural Engineering are as follows: (1) The population is largely rural; (2) many jobs are available in both agriculture and industry and the institutes have a very close connection with both; (3) the government pays more money for engineers who work in agriculture than for the engineers who work in industry.

Faculty

Teachers are appointed for a 5-year term. They must reapply and must have done an approved job to maintain the appointment. Pay is based on production, not length of service. There is considerable competition for vacancies, because the pay is higher in educational institutions than in industry.

A professor works 6 hours per day, 6 days per week. Two hours per day of lectures is considered a full load. Teachers in institutes usually spend about 50 percent of their time on research. In practice they spend about one-fourth of their time on research during the regular teaching year and the other fourth in preparation of lectures and classes and counseling with students. Postgraduate (graduate) degree programs are available in institutes with well-trained staffs. The university and institute teacher is both respected and well paid. All salaries are set by the U.S.S.R. Council of Ministers. The base salary does not represent total income, because additional pay may be earned by approval of a new machine design, consulting with industry, committee work, and writing. Examples of the monthly starting salaries of several jobs follow:

	Rubles
Minimum wage in U.S.S.R.	350
Elementary teaching	580
Upper grade school	780
Technical workers	500-1,500
Starting engineer	900
Foreman	2,000
Chief engineer	2,000
College teacher with Candidate of Technical Science Degree	2,700
University teacher	3,300
College teacher with Doctor of Technical Science Degree	4,000
Professor with 10 years of service	5,500
Academician	6,000

Outstanding research workers can be appointed as Academicians and receive extra pay in addition to their regular salaries. The most respected appointment is Academician of the All-Union Academy of Science. Similar recognition may be given by the Academy of Agricultural Science and by several of the republics which have an Academy of Science separate from the National Academy. Fifty percent extra pay can be received by working with industry as a consultant.

The man who developed a mower that was later manufactured received the maximum cash award of 200,000 rubles. The maximum payment for an "idea" is 20,000 rubles. In all, 17,000 premiums were paid to engineers in agriculture in 1957. These awards provide a tremendous incentive. Patents may be granted to citizens of the U.S.S.R.

There is one faculty member for each 10 to 12 undergraduate students, while 4 to 6 graduate students may be assigned to top-ranking faculty members to do research for advanced degrees. There is one teacher for each 60 correspondence students. About 15 percent of the faculty hold full professor rank.

A relatively high percentage of the teaching and research staffs can read English—a few can speak it to a limited extent. One language in addition to Russian is required in the 5-year program.

Faculty members usually live close to the institute or university in housing provided. Few of them have cars.

Laboratory Facilities

The various institutes had excellent laboratory facilities and instruments, which were used interchangeably for teaching and research. Included was equipment for testing diesel pumps; vibration analysis; metallurgical, grain structure, and hardness of material; electrical generation; machine shop, forging, and foundry work; measurements;

harvesting; and spark plugs and electrical study. Also available were very accurate instruments, such as a large electron microscope, a universal microscope for measuring roughness, and equipment for the use of radioactive materials. In two institutes, each laboratory had at least one oscilloscope and some had several.

Charts and visual aids for teaching were excellent, including cut-away machines and tractors, with charts describing their operation. One institute had 30 kilometers of movie film specially prepared for teaching.

Excellent facilities for drafting were available. A typical drafting laboratory included 50 to 75 tables equipped with automatic drawing devices. The student must work on his drawing during class or at odd times but not outside of the laboratory. Drawings are not returned at the end of the year.

Classroom sections were organized on the basis of 30 students. Where considerable laboratory equipment was involved, half sections of 15 students were organized. An instructor was always on duty to help the students, and technicians were available for operating the equipment and for shopwork.

Books

One is impressed by the large number of technical books on specialized subjects available for students and scientists. Authors are relieved of teaching and research responsibilities for writing; a 3-month leave at full pay may be granted by the institute director and longer periods of leave at full pay may be granted with approval of the Board of Agricultural Science. After the book is published, the writer gets a cash payment. The Ferguson series of Agricultural Engineering texts is now being translated for use in Russia. There are many book stores in the cities and the people have the habit of reading.

Correspondence Courses

Many of the institutes offer correspondence courses. These courses require 6 years of concentrated study and students must spend from 1 to 10 months per year at the institute for refresher lectures and consultation. Students may be over 35 years of age. The student must be working in the area of his study so that his experience will replace the practical material normally covered in the regular 5-year program. Correspondence students may take 45 days leave or vacation from their work, of which a month is spent at the institute for study.

Foreign Languages

Considerable emphasis is placed on teaching foreign languages in the secondary schools. The greatest emphasis is given to English, German, and French. Universities require two foreign languages and institutes require one for entrance. Most 10-year schools start foreign language training in the fifth year. Sixty-five percent of the students select English as an additional language. In a few experimental schools, all courses are taught in a foreign language. For example, a student

Figure 13.--Cut-away tractor engine in teaching laboratory. (BN-8906)

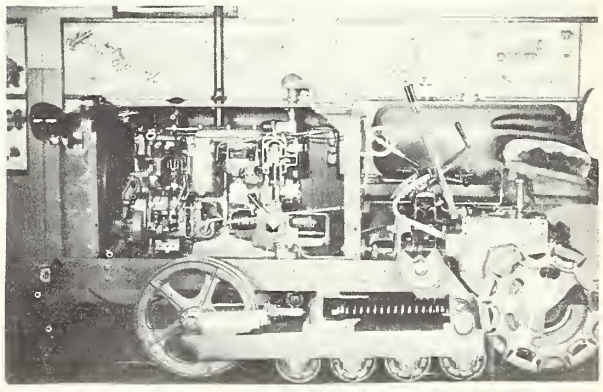


Figure 14.--Cut-away tractor in teaching laboratory. (BN-8907)

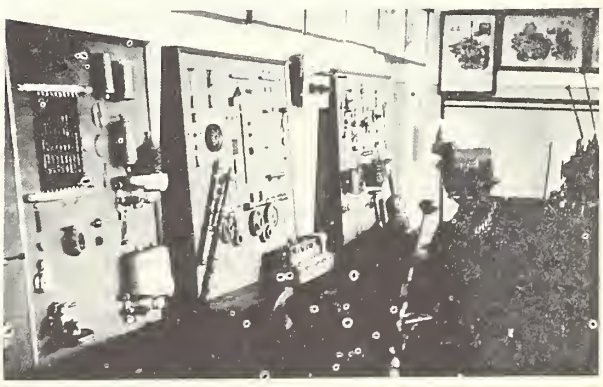


Figure 15.--Panels for parts in engine instruction laboratory. (BN-8908)

studies all of his subject matter courses in English from the first grade through graduation.

Library

Each institute has its own library facilities and may have 20,000 to 25,000 volumes. For additional references, the Lenin Library in Moscow is used which, it is claimed, has over 20 million volumes. For scientific workers it has a special room equipped with individual desks. The University of Moscow has a main library as well as a library for each department.

Most institutes have one or more translators of foreign publications, and in each institute we visited an English translator was available. Many scientific workers read technical publications in English. It is of interest to note that over 200 copies of Agricultural Engineering go to the U.S.S.R. each month.

Publications

A display of magazines and journals of particular interest to agricultural engineers at the Institute for Mechanization and Electrification in Moscow included the following:

(1) Mechanization and Electrification of Soviet Agriculture, published by the Ministry of Agriculture. Considered good Agricultural Engineering reference.

(2) Instruments for Experimentation, published by the Academy of Science, Moscow.

(3) Hydraulic Engineering and Amelioration, published by the Ministry of Agriculture.

(4) Science and Progressive Methods of Agriculture, published by the Ministry of Agriculture.

(5) Tractor and Agricultural Machine Building (for Engineers and Technicians) published by the U.S.S.R. Academy of Science.

(6) Tractors and Agricultural Machines, published by the State Scientific Council for Technical Information under the Council of Ministers of the U.S.S.R. Considered very good Agricultural Engineering reference.

(7) Technical Advice to Collective Farms, RTS's, MTS's, and State Farms, published by the Ministry of Agriculture.

(8) Farm Construction, published by the Ministry of Agriculture. Appeared to be good for Agricultural Engineering reference.

(9) Agriculture, a bibliography that summarizes all foreign publications, published every 10 days by the Academy of Agricultural Sciences.

(10) The Herald of Agricultural Science, which includes an English summary, published by the Academy of Agricultural Sciences.

(11) Dairy Industry (Milk Processing), published by the State Scientific Council for Technical information.

University Training

The University of Moscow is the epitome of education in the U.S.S.R. It is located principally in one building and includes living facilities for students and staff. Each undergraduate student has 8 square meters of study and sleeping area. Practically all students receive stipends. There are 2,000 faculty members to teach 17,000 students, including 6,000 night school students and 1,500 graduate students. More girls than boys attend the University. Beginning in 1959, the entrance requirements will be changed so that in addition to passing an entrance examination, 80 percent of the new students will have had 2 years' experience after high school. The University has 12 departments, as follows: Physical, Chemical, Mathematical, Geological, Geographical, Philosophical, Historical, Philogical, Economics, Law, Journalism, and Biology and Soil. Basic sciences and nonsciences are taught at the University, but not engineering.

Universities in other major cities, such as Kiev, Minsk, and Kharkov, are patterned after the University of Moscow.

Conclusions

(1) Better use of foreign publications is being made in the U.S.S.R. than in the U.S.A. This is partly due to the ability of the Russians to read foreign languages and to the availability of translators at each institute.

(2) Laboratories are very well equipped, but it must be remembered that some of the tools are used in connection with governmental activities in development, design, and testing of equipment.

(3) Research tools, such as instrumentation equipment, are plentiful and excellent quality but are not being used as extensively as is the practice in the U.S.A.

(4) There is a high ratio of faculty to students--nearly twice that in the U.S.A. There is more individual project work in the undergraduate program, the Diploma Engineer degree requiring a thesis.

(5) Although a high percentage of those who enter complete their training in the U.S.S.R., entrance is based on an examination. Even though the number of dropouts because of failure is higher in the U.S.A., this method seems to be fairer for students coming from all types of high school backgrounds with different educational standards.

(6) The idea that faculty members in the institutes are paid so much more than their counterparts in America is exaggerated. In terms of actual standard of living, their returns are lower.

(7) There is greater opportunity for faculty members to earn money, in addition to their regular salary, than would be expected in the U.S.A.

(8) Great scientific progress is being made in the U.S.S.R. Scientific workers in the U.S.A. must pay more attention to the findings of Soviet workers to avoid doing work already reported.

(9) Engineering students in the U.S.A. get better instruction in the important basic subjects than engineering students in the Soviet institutes. The best teachers in mathematics in the U.S.S.R. will normally go to the University where their professional standing is greater. The college and university system in the U.S.A. is best for training for the needs of America, while the method in U.S.S.R. is the best for their conditions at present. Graduates in the U.S.A. have more flexibility of job opportunities.

(10) The demand for students in specific fields can be expected to fluctuate greatly according to need and pay as established by government planning boards.

(11) Textbooks which are available with a large amount of technical and theoretical information are useful in providing excellent training in agricultural engineering.

ELECTRIC POWER AND PROCESSING

Nearly all of the 5,800 state farms and 78,000 (about 40 percent) of the collective farms are electrified. This means that about 50 percent of the farms in the U.S.S.R. are electrified, which was the percentage of electrified farms in the U.S.A. in 1945.

Electricity is provided by stationary steam and hydroelectric plants, such as the one we visited in Zaporozhe, or by individual generating stations, usually powered with diesel engines, on the farm. Recent information from the U.S.S.R. indicates that future electric power supply will be developed mainly from steam power. The U.S.S.R. power stations produced 182,000,000 kw.-hr. of electricity in 1956 compared to 3.8 billion kw.-hr. for the U.S.A. Electricity is generally 50 cycle and is used at 127/220 volts or 220/380 volts. One might find either 127 or 220 volts used for lighting circuits and usually 220 or 380 volts for power circuits. Standard highline voltages are 10 kv. and 35 kv.

The Lenin Collective Farm near Zaporozhe had a total power requirement from highline of 800 kw. with six stationary substations. This farm covered about 10,000 acres and was quite diversified with cereals, vegetables, fruit, and animal husbandry enterprises including 1,600 cattle. Ninety percent of the electrified collective farms are served by highlines.

At a 20,000-acre farm near Shipunovo in Siberia, the stationary local power plant provided 500 kw., and at the 35,000-acre Grain State Farm near Krasnodar the local power plant supplied about 1,500 kw. At the Telman Collective Farm at Minsk (about 3,500 acres and with a large livestock enterprise) 60 electric motors used 220,000 kw.-hr. per year.

The cost of electricity is 10 to 19 kopecks per kw.-hr. (Zaporozhe), about the same as in the U.S.A.

The Lenin hydroelectric power plant in Zaporozhe is generally off-limits, but we were shown the facilities. The dam for the plant on the Dneiper River is 750 meters long, is arched upstream, and has a 36-meter water height. The diameter of the water tubes to the turbine is 7.5 meters. Nine generators are now in use, including three imported General Electric generators. The capacity of each generator is 13,800 kw. The plant was neat and well managed, with six people operating the generating facilities.

The educational and training program for electrification is, in general, taught in the Institutes for Mechanization and Electrification of Agriculture, and is very similar to the program for electrical engineers in the U.S.A. a few years ago. In Moscow, the Institute for Electrification of Agriculture offers such courses as Thermodynamics and Steam, 150 hours; Electrical Engineering, 130 hours; Electrical Drive and Application of Electricity to Agriculture for Light and Heat, 100 hours; and Transmission and Generation of Electricity. Three-phase electricity receives considerable emphasis. Most Institutes for Agricultural Engineering cover both mechanization and electrification.

The leading electrification research for the U.S.S.R., as mentioned previously, was being done in the Research Institute of Electrification of Agriculture at Zaporozhe. The institute is affiliated with the Moscow Research Institute and its objective is to apply electricity to agriculture. The institute has its own experimental farms. The major work covers the following: (1) Application of electricity to threshing and cleaning, (2) development of an electric tractor, of which they have made 80, (3) automation of check-row planting, (4) orchard uses of electricity, (5) irrigation in the southern part of the Ukraine, (6) orchard sprinkler irrigation, (7) application of electricity to hotbeds and greenhouses, (8) influence of light on plants, (9) use of high frequency electricity in drying agricultural products, and (10) electrification of farmstead buildings.

The institute was determining critical voltages for livestock and for humans. Tests were being run to determine the effectiveness of infrared for drying and for insect control. An infrared source was being used to disinfect feedbags.

Considerable emphasis was being placed on the use of electricity for farmstead enterprises, such

as handling manure, ensilage, and feed. Work is being done on cooking fodder for livestock. In other research, feed was being moved from silo storage to the front of the animals by push-pull conveyors, and dropped from the bottom of the conveyors to feed all cows in a stall barn at the same time.

High frequency current was being used for crystallization and surface hardening of metal. High frequency brazing was being accomplished by using a frequency of 500,000 cycles per second at 8 kv. The brazing material was supplied by feeding a metal rod into the work at 1 to 2 mm. per revolution of the 2-inch diameter shaft being treated.

Use of high frequency current in a vacuum drier was receiving considerable attention. Hay briquettes 10 cm. thick were dried, using a frequency of 3 megacycles in a vacuum of 50 mm. of mercury. The procedure was to dry alfalfa and clover in the field to a moisture content of about 35 to 40 percent. The hay was then baled into briquettes and dried in a vacuum oven at 50° C. (122° F.); 2 hours was required to decrease the moisture content to 8 percent, and 1 kw.-hr. of electricity was required to produce 5 pounds of dry hay.

Considerable effort is being devoted to development of equipment and processes for utilizing methane and producing fertilizer from livestock manure. Two large methane tanks were being built to produce the equivalent of 25 kw. of electricity. The gas produced will be compressed into metal cylinders and all the manure will be handled mechanically. Production of 250 cubic meters of methane gas per day and 2,500 tons of organic matter per year from 100 cows is expected.

The interconnection of wind-propelled generators with powerlines was being investigated. Use of reinforced concrete poles or bottoms to poles for supporting electric transmission lines was being developed and applied in a few places.

Use of electricity in the dairy enterprise is receiving considerable attention. Twenty-four automatic feed mills were put into operation last year. Litter carriers, water cups, and feed carts are used on many dairy farms. Most cows are milked in stanchion barns and the milk is separated on the farm or placed in a large bulk tanker for transporting to town for cooling and processing. Some farms have electric-driven milking machines; and on most farms young girls, or milkmaids, each milk 10 to 20 cows 3 times daily. During the summer cows are kept in shed-type shelters, which have open sides and consist mainly of a roof with supports. Research is being done on farm bulk cooling of milk and we saw a one-half ton refrigerated vertical cylindrical bulk tank of double wall construction.

In one place research was being conducted on an electric-driven mower with a diesel 54-hp. tractor engine operating a mounted generator that produced 25 kw. alternating current at 220 volts. Seven mowers with a total cut of 14.7 meters were mounted on the track-type unit. The mowers were driven by electric motors. A 1.7-kw. motor was used on each of 4 side cutterbars and one 4.5-kw. motor was used for the 3 front cutterbars. Overload protection was provided for the motors. The motor speed for the mowers was 940 r.p.m. The application appears useful for wide machines. It was stated that the use of electric motors brought about a saving of 220 pounds of metal.

Considerable work has been done on developing an electric tractor, which is basically a 54-hp. track-type tractor with a 40-kw. (50 to 60 hp.) electric motor connected to a 6 to 10 kv. highline. Reports as to the voltage actually supplied to the motor differed; it may be 1,000 or it may be 380. The electric tractor operated at 3 to 5 km. per hour, pulled a plow 1.75 meters wide, with a depth of cut of 28 cm. A 4-wire cable 750 meters long, with a cross section 10 mm^2 per wire, was used to supply electricity.

Most large state and collective farms had heated air drying equipment for grain. All driers were the vertical column type with inverted open bottom channels approximately 1 foot apart for directing the air flow. Alternate channels were for air inlet and outlet. Wood, peat, and coal were used for fuel. The temperature into the drier was 150° to 170° C., and leaving the dryer, 20°. Wheat, the principal crop dried, was reduced to a moisture content of about 13 percent.

Typical uses of electricity on the farm were for cleaners, elevators, milking machines, conveyors, and lighting, and for small motors for miscellaneous jobs. Electricity in the home was mainly for lighting purposes.

Prices of electrical equipment were as follows:

	Rubles
Vacuum cleaner (average)	400
Vacuum cleaner (tank type)	650
Washing machine and motor (no wringer)	2,250
Light bulb, 75 w.	3.3
Table radio	245 to 1,500
Record player-small table model	245
17-inch TV	2,500
Alarm clock	55
Electric razor (Norelco type)	225
Refrigerator (small apartment size)	750
Refrigerator (similar to 8-10 cu. ft.)	2,000

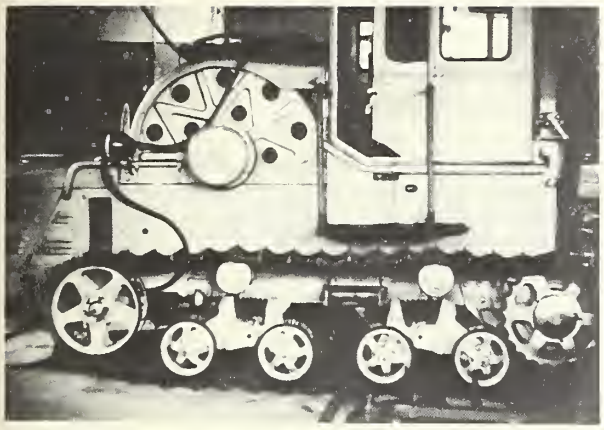


Figure 16.--Experimental tractor powered by an electric motor. (The Institute for Mechanization and Electrification of Agriculture, Moscow.)

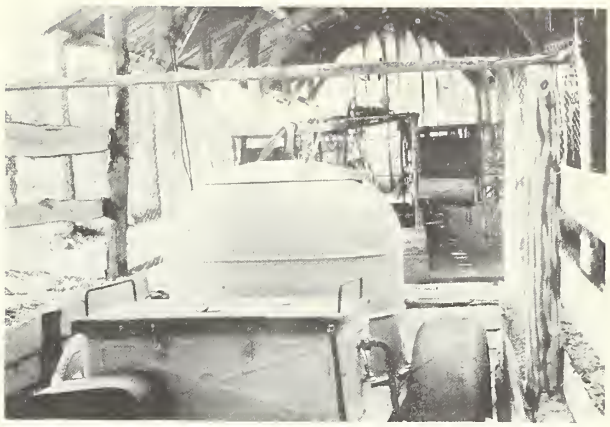


Figure 18.--A cylindrical, vertical double-wall refrigerated bulk tank and trailer; capacity, 1,000 pounds; 1.7 kw. electric motor on compressor. (BN-8910)

Figure 17.--Tunnel dryer for small seeds on display at the Agricultural and Industrial Exhibit in Moscow. (BN-8909)

Figure 19.--Trailers for hauling bulk milk from surrounding farms. (Moscow Milk Combine.)

TRACTORS AND OTHER FARM MACHINERY

Farm mechanization in the U.S.S.R. began in 1929 when state farms were established. At the same time, institutes for mechanization research were started. The original tractor and implement factories used many American machines as prototypes; however, the present Soviet designers are developing their own versions of machines suitable for their conditions.

Although many factories were destroyed during World War II, many new factories have been built and old ones have been rebuilt. Designs for new machines are supplied by the various Institutes for Design and Testing (principal ones in Moscow) and by the Central Construction Bureau in Zaporozhe.

Machines are produced in subassembly and assembly lines, very similar to those in the U.S.A., but with less output per worker. The workers do more handwork and there are many more women than in a factory in the U.S.A. At one typical tractor plant the employees work 7-1/2 hours on weekdays and 6 hours on Saturday, a total of 43-1/2 hours. We were told that, beginning next year, they will work 7 hours on weekdays plus 6 hours on Saturday, a total of 41 hours. Nurseries are provided for the children of working mothers. Seventy-six days of maternity leave is provided.

Production incentives are highly regarded as a way of increasing production per worker. Factory and government representatives establish production goals for each plant. These goals seem to be characteristically set lower than the expected, since actual production is usually 120 to 130 percent of the goal. For example, at one plant, workers that meet their goal get 20 percent above the base pay, plus 2 percent increase in pay for each 1 percent above the goal. The monthly base pay rates at this plant were:

	Rubles
Factory workers	930
Engineers	1,300-1,500
Department head	2,200
Director	3,000

The Soviet Union has a patent system for citizens. Premiums up to 200,000 rubles are paid to designers for developing successful machinery. However, premiums are paid if and when the machine gains acceptance, not when the patent is secured. The amount of the premium depends on an estimate of the annual saving to the Government by reducing the cost of production.

Permission must be obtained from GOSPLAN, for a tractor or machinery manufacturing plant to extend its facilities. One tractor factory we visited indicated an investment of 1 ruble for each 1.6 rubles of production. In general, about 60 percent of the expenses are for materials, 15 percent for wages, and 25 percent for overhead.

Tractor Production

Three nonfarm crawler tractors are now in production—about 75 to 100 daily of the C-100 at Chelyabinsk in the Ural Mountains, approximately 20 daily of the TDT logging tractor in Minsk, and an undetermined number of the TDT logging tractor in Petrozavodsk about 125 miles northeast of Leningrad.

Six basic models of farm tractors are currently in production. All have diesel engines. Estimated daily production is 545, of which 52 percent are crawlers and 48 percent are wheel tractors. Production of the different models at the various locations is shown in table 2.

Table 2.—Estimated daily production of agricultural tractors in Russia

Location of factory, and kind of tractor	Wheel	Crawler	Employees
	Number	Number	Numbers
Minsk	---	---	11,000
Wheel	100		
MT3-5M 10 speeds-45 HP			
MT3-5K (Torque Ampli) 45 HP			
MT3-7 (1959 - 45 HP) 4WD			
Logging Crawler, TDT40	---	20	
Kharkov	---	---	27,000
Crawler	---	80	
DT54 (1958)			
DT56 (1959)			
Wheel-Single Cylinder, DT20	80		
Self Propelled Chassis	20		
Altai (Rubtsobsk):			
Crawler, DT54	---	40	
Stalingrad:			
Crawler	---	110	
DT54 (1958)			
DT57 (1959)			
Lipitz:			
Crawler	---	55	
KDT-35-KAD35			
High Clearance, KD40			
Vladimir:			
Wheel	60	---	
DT24 (1958)			
DT28 (1959 Model)			
Total	[1]260	[1]285	

[1] These totals do not include the Model TDT60 logging tractors built at Petrozavodsk, the C-80 and C-100 industrial tractors built at Chelyabinsk, or the logging tractors built at Kharkov.

Tractor Design

In general, Russian agriculturai tractors are heavier, for a given horsepower, than tractors manufactured in the U.S.A. Although reasons for this were not discussed at great length, several may apply. In the first place, the engineers do not wish to take any chances of a machine failing, as this is looked on with much disfavor in official circles. Second, because of the very large size of the collective and state farms and because the machines are likely to be run on a 2-shift basis during busy seasons, the machines are likely to be operated a greater number of hours per year. Third, at the time the tractors were designed, the materials may not have been equal to those available today.

As mentioned previously, slightly more than one-half the present farm tractors are the crawler type as contrasted to only about 4 percent in the U.S.A. However, owing to increased emphasis on row crops, production of wheel tractors is to be greatly increased so that by 1965 wheel tractors will make up 70 percent of the total.

Much work has been done on developing air-cooled diesel engines for tractors. The Kharkov Tractor Factory has developed a 2-cylinder 20-hp. air-cooled engine, which is being placed into a pre-production pilot run of tractors at the Kharkov Tractor Assembly Plant. A 4-cylinder air-cooled diesel was on exhibit at the Agricultural Exhibition in Moscow, and we were told that a special plant was planned to manufacture air-cooled engines for all requirements.

One very interesting experimental development at the Kharkov factory was a process for rolling spur gears. The blanks were induction heated around the circumference after which the gear teeth could be formed by a few turns of the master pattern. Increased life and beam strength were claimed over cut gears.

The development of machines and techniques for increasing the operational speed of implements was receiving much attention of designers and the research institutes. The goal of the designers is to at least double present speeds.

Tracks for the present Russian agricultural crawler tractors are fabricated completely from unmachined castings. The track links are cast of austenitic steel with at least 13 percent manganese. It is not possible to machine the links, and they are assembled just as cleaned in the foundry. Carburized, hardened pins are driven into place, and the track is complete and ready to go. Although the tracks do not wear as long as more precisely made ones, the simplicity and low cost were said to more than offset the difference. One Repair Technical Station indicated that it supplied a complete set of tracks with pins weighing 1,400 pounds per pair, for 900 rubles delivered ($90 at tourist exchange rates). In comparison, a pair of 11-38/6 ply rubber tires and tubes cost 1,300 rubles.

A Combine Plant

The "Rostelmash" plant, in Rostov-on-Don, was completed in 1931. Various machines, including combines, plows, seeders, cultivators, mowers, windrowers, and corn pickers, were manufactured during the periods 1931-41 and 1944-56. (The plant did not operate during the war.)

In 1957, production was shifted to the SK-3 self-propelled combine only. Approximately 40,000 units were said to have been produced in the 12 months preceding our visit. Engines for the combine are made by the Hammer and Sickle plant in Kharkov. This plant cooperates with teaching and research institutes, other manufacturing bureaus, and machine test stations.

The Rostelmash plant is working toward the development of several different machines that will mount on a 60-horsepower self-propelled chassis. Displayed models of the proposed machines included a combine, double windrower, baler, wagon, manure spreader, and ensilage cutter.

A "professional" conference is held periodically to discuss machine design and development problems. In 1958, this conference lasted 8 days. Apparently it is similar to meetings of our professional groups.

The design and specifications for a new machine are submitted to the scientific council for approval, although it is possible to do a limited amount of experimental work without direct approval of the council. The SK-3 combine was cited as an example. The idea of developing a self-propelled combine was contrary to the thinking of the council and 2 years' work was done on it before approval was given for research and development. Then the council gave the design and development job to two bureaus and selected the best of the two designs.

Figure 20.--Exhibit of one of each model tractor manufactured at the Minsk Tractor Plant. (BN-8911)

Figure 21.--Sign at Minsk Tractor Plant; "1% increase in efficiency means hundreds of Belaruss tractors over the quota." (BN-8912)

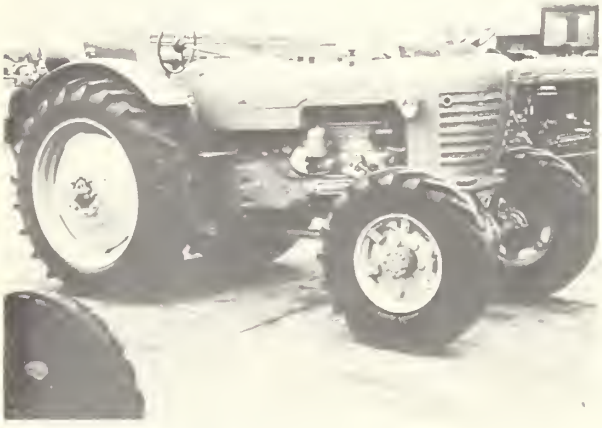


Figure 22.--A 4-wheel drive tractor at the Minsk Tractor Plant. (BN-8913)

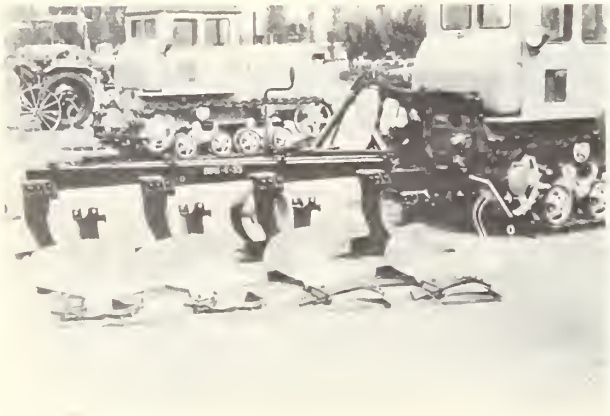


Figure 23.--Newer tractors are equipped with mounted hitches. (BN-8914)

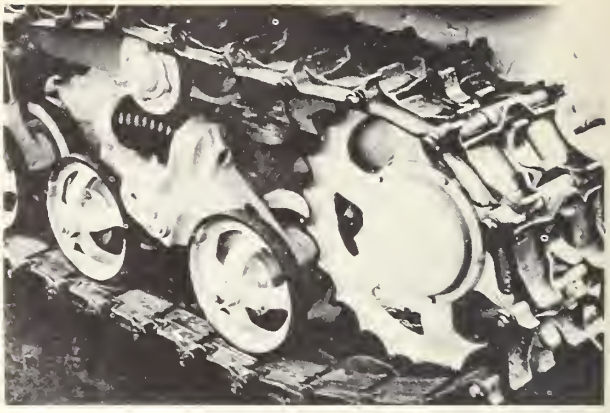


Figure 24.--The Bogey wheel and track tension arrangement on the most common diesel crawler, the DT-54. (BN-8915)

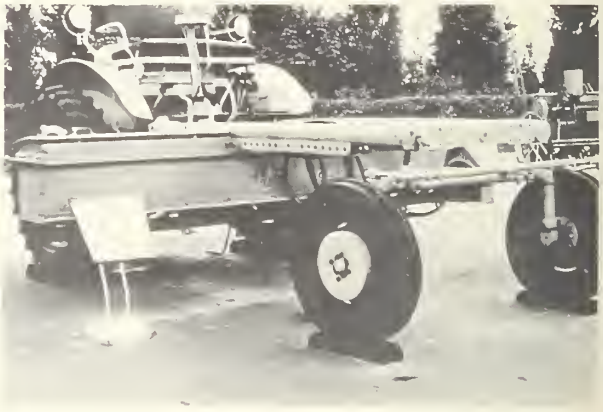


Figure 25.--Small self-propelled chassis on exhibit at the Agricultural Exhibition, Kiev. The seeding device is one of a number of machines designed for this unit. (BN-8916)

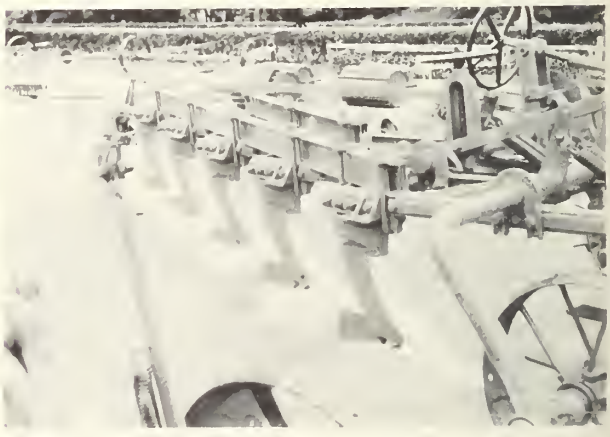


Figure 26.--The "Maltsev" plow at the Agricultural and Industrial Exhibition, Moscow. Most of the moldboards have been cut away. The plow is used about once in 4 years to loosen the soil without inversion. (BN-8917)

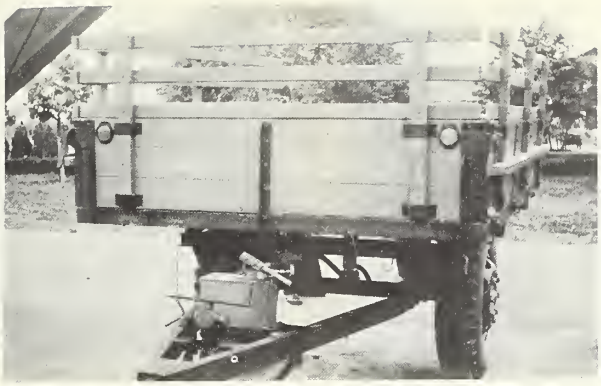


Figure 27.--Hydraulic dump trailer at the Agricultural Exhibition, Kiev. The trailer will dump to either side or to the rear. (BN-8918)

FARM BUILDINGS

Farm building construction in Russia compares to that in the U.S.A. from about 1910 to the 1920's. Practically all buildings for housing livestock are made of lumber. One-story buildings predominate; feed materials are stored on the ground. Uses of electricity are being developed for handling materials around the farmstead, but little is being done to use electricity around the farm home for more than lighting. The Agricultural Engineering Research and Teaching Institutes are now beginning to incorporate farm structures as one of their activities. Most of the emphasis to date has been on developing equipment for handling materials rather than on design of the structure.

Housing

The average area available for housing in the U.S.S.R. is 7.7 square meters (81 square feet) per person. On many collective and state farms, houses are being constructed for individual families. For a while, large dormitory-style buildings that housed several families were built, but this does not appear to be the trend today.

A family may secure a loan on a 10-year basis and build a house on land on a collective farm. The impression was given that this loan is not always available but depends on the financial situation of the collective farm. Families on the collective farm will often work together to help a family erect a house. A fee, which represents rent of the land or taxes, is paid to the government. Homes are constructed of wood, logs, concrete block, brick, or rammed earth. Floors are usually made of wood and covered with a throw-rug. Electricity is now available in many homes but is used principally for lighting and not for appliances.

Fuel for cooking and heating consists of wood, coal, dried peat, or dried-manure bricks. Manure is cut in bricks, stacked out-of-doors in the sun, and permitted to dry. These bricks are then used for fuel. It costs 150 to 200 rubles a year to heat a home. A dug-well forms the water supply on most of the farms; several families use the same dug-well. For livestock enterprises, the water is pumped to a tower from which it can be used for watering the animals or for dairy cleaning operations.

Recently, research in farm structures has become an important part of the program in the Institutes of Agricultural Engineering. The objective is to reduce the labor requirements around the farmstead which includes developing equipment for handling feed and products and improving the design of structures to facilitate the use of handling equipment. A good magazine entitled Farm Construction is now published in Russian by the Ministry of Agriculture of the U.S.S.R., Moscow. More emphasis has been placed on improving operations for the farmstead than for the home.

An apartment in town included two rooms plus kitchen and bath, for which the rent was 58 rubles per month plus 3 rubles for guests plus 6 to 7 rubles per month for electricity. New apartment houses were heated from a central plant by hot water. Some of the older apartment houses had a common tap outside the house for the water supply. In all the towns we visited, there was tremendous activity in building apartment houses. Much of the construction work was being done by women, and the principal type of construction was concrete blocks or precast concrete covered with stucco. The quality of workmanship appeared to be lower than average.

Figure 28.--A typical thatch-covered house in the Ukraine. (BN-8919)

Figure 29.--A log house near Barnaul in Siberia. Frequently the logs were marked with numbers indicating prefabrication.

Figure 30.--A new farm home near Barnaul.

Figure 31.--Grain drying and storage shed, Rodina Collective Farm, near Barnaul. Three tiltable panels made up the south roof slope of the shed.

Dairy Structures

Practically all buildings are a 1-story type of construction made of wood. Some dairy stables are equipped with watering cups, manure carrier track, milking machines, and feed carts. The stall and manger layout is very similar to that in the U.S.A., except that the stanchions and mangers are made of wood and the platform on which the animal stands is usually made of wood.

It is the practice in most areas, even in Central Siberia, to move the dairy cows to a different barn for summer milking and feeding. This is a pole-type structure; usually it has a gable roof, is rather simply constructed, and has a field power station for furnishing electricity for milking machines and light.

The forage is normally stored on the ground in a separate structure adjacent or close to the dairy barn. A manure storage shed was constructed as part of each permanent dairy barn. Although we saw no milking parlors in operation we were told that there are 1,000 in the U.S.S.R. One milkmaid handles 40 cows in a milking parlor. It is the practice to bring a considerable amount of straw from the field to the buildings after combining. This straw is normally placed in nicely formed stacks near the buildings. Research work was being done on transporting straw from the field to the barn on large wagons, from which the straw was then arranged to form a stack.

Silos

Most of the silos are the belowground type and are made in round, square, or rectangular cross sections approximately 5 meters deep and 5 meters across. The length varies with the size. On a research basis, the large straw piles were being used as the sides of aboveground horizontal silos and the chopped silage was covered with straw. The researchers claimed a loss of only 6.5 percent in these silos. In an experimental setup, the silage from the storage unit was first torn loose by the operator and then moved by an oscillating conveyor to the barn and placed in front of the dairy cows mechanically. We did not see any vertical silos in the U.S.S.R.

Figure 32.--Most of the silage in the U.S.S.R. is stored in trench silos. Unloading is often accomplished with dump trucks or winches. (BN-8920)

Figure 33.--Milk cows are often quartered in summer barns similar to the one shown. In winter they are kept in enclosed shelters.

Figure 34.--Milkmaids on the Telman Collective Farm, near Minsk. Electric milking machines were used by these women to milk about 200 cows, three times each day. (BN-8921)

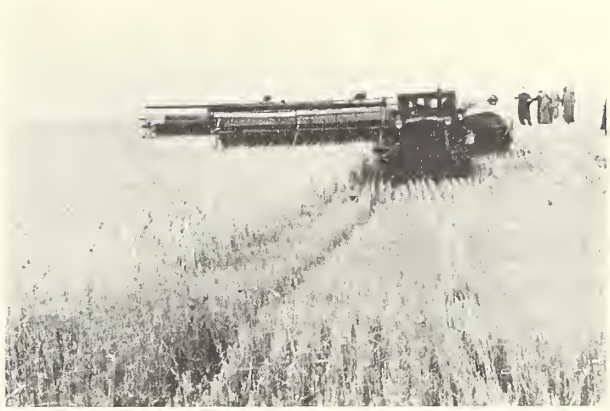


Figure 35.--Two windrowers pulled by one crawler tractor. Windrowing wheat near Barnaul in Siberia. (BN-8923)

Figure 36.--A straw "sled" pulled behind a combine to simplify later gathering of the straw for use in livestock production. Note the large "buncher" mounted on the combine; about four bunches fall onto the sled, after which they are later collected and placed in a stack at the edge of the field or at the barn. (BN-8922)

Figure 37.--Two large trail-type combines pulled behind one 80 horsepower crawler tractor near Barnaul in Siberia. It is planned that self-propelled combines will gradually replace these trail-type units.

Miscellaneous

Lumbering is a large industry in the Central Siberian area around Barnaul. Logs are sent to the sawmill by train and by river. A start has been made in prefabrication of buildings in which the log structures are cut out at a central point, numbered with (red) paint, then shipped to the site where another crew erects the building.

From the road we often saw herds of cattle, sheep, and horses, grazing in the fields. No fences are used in the farmland. A few barnyard areas are fenced. Conventional chicken wire was used for poultry and wooden fences for larger livestock. We did not see any woven wire fence.

Galvanized steel, thatch, and tile were the major roof coverings for houses and other farm structures.

Many women work as engineers, foremen, and miscellaneous workers in building construction. Large cranes were very numerous in the cities and used to lift materials from the ground to the level at which construction was taking place. Rural roads were dirt construction and very slippery when wet.

SUMMARY

The manufacture and distribution of farm machinery in the U.S.S.R. is controlled by GOSPLAN, the overall state planning commission. GOSPLAN is divided into about 25 sections; one section is concerned with automobiles, tractors, and farm equipment. Although many older machines show evidence of being patterned after U.S. models, new machines are largely of Soviet design. The machinery manufactured in the U.S.S.R. is on display in the impressive All-Union Agricultural and Industrial Exhibition in Moscow.

Machine Tractor Stations, the first of which was established in 1928, formerly owned and managed the equipment used on collective farms. However, state farms owned and operated their own machinery. The divided responsibility between the machine tractor stations and the collective farms apparently resulted in general inefficiency and, in 1958, ownership of the machines was taken over by the collective farms. At this time Repair Technical Stations (RTS) were set up for central control of major repairs and other services.

Machine Test Stations, not to be confused with Machine Tractor Stations, have been organized to evaluate prototype machines developed by the various research and machine building institutes and bureaus. Twenty-three test stations were operating at the time of our visit.

Farm machines are produced in subassembly and assembly lines, similar to those in the U.S.A., but with less output per worker. The work week in the factories, at the time of our visit, was 43-1/2 hours. Production incentives are highly regarded as a way of increasing production per worker. Goals are established for each plant and awards made to those who meet and exceed the quota. Premiums are also paid to designers for developing machines that gain acceptance.

Farm building development in the U.S.S.R. has lagged behind farm machinery development. Electricity is used for many tasks around the farmstead, such as grain cleaning and operation of milking machines. It is also available in many of the homes but is used principally for lighting and not for appliances.

As in the U.S.A., institutions for educating the Soviet "agricultural engineer" carry on programs of research as well as teaching. In addition, other research institutes and construction bureaus are charged specifically with the development of new machines. The institutes appeared to be staffed by competent engineers who were well supplied with research tools and instruments.

The U.S.S.R. has seven institutes for the mechanization and electrification of agriculture where agricultural engineers are trained. The typical engineering diploma graduate (approximately equal to a B.S. degree in the U.S.A.) will have completed 10 years in grade and high school plus 5 years of institute study or he will have completed 7 years of grade school plus 4 years of technical high school plus 5 years of institute study. Graduate work is offered in some institutes.

APPENDIX

Farm Equipment Statistics, U.S.S.R.

Kind of equipment	Production, 1957	Approximate total on farms, end of 1958
	Number	Number
Tractors	[1]204,000	[2]1,000,000
Trucks	104,000	660,000
Grain combines	131,000	500,000
Corn pickers and forage harvesters	51,000	170,000
Sugar beet harvesters	8,600	30,000
Windrowers	----	330,000
Cotton pickers	----	26,000
Balers	----	2,000
Mowers	46,000	----
Plows	128,000	----
Planting drills	278,000	----
Cultivators	208,000	----

[1]Operating at capacity. For purposes of comparison, the U.S.A. manufactured 275,000 tractors in 1957.
[2]52 percent crawlers. The U.S.A. had 4,500,000 tractors on farms at the end of 1958.

Technical Description of Some Tractors Manufactured in the U.S.S.R.

Tractor S-100 and S-100 B

Type of tractor . . . . . Tracklaying, for heavy agricultural work
Type of engine . . . . . Diesel, four-stroke
Nominal horsepower of engine . . . . . 100 h.p.
Specific fuel consumption . . . . . 200 g/effective h.p./h.
Class of tractor VII
Maximum drawbar pull in low gear . . . . . 9,000 kg.
Speed . . . . . 2.3 to 10.1 km/h
Modified model . . . . . S-100 B (marsh)
Weight of tractor S-100 . . . . . 11,400 kg.
Weight of tractor S-100 B . . . . . 13,200 kg.
Specific pressure on ground:
S-100 . . . . . 0.5 kg/cm^2
S-100 B . . . . . 0.24 kg/cm^2
Additional equipment . . . . . Separate-unit hydraulic control system with coupling device, power take-off shaft for land utility work.

Tractor DT-54 M

Type of tractor . . . . . Tracklaying
Type of engine . . . . . Diesel, four-stroke
Nominal horsepower of engine . . . . . 75 h.p.
Specific fuel consumption . . . . . 190-195 g/effective h.p./h.
Class of tractor V
Maximum drawbar pull in low gear . . . . . 3,950 kg.
Speed . . . . . 0.82 to 10.4 km/h
Modified models . . . . . DT-55 (marsh)
DT-57 (steep-slope)
Weight of tractor . . . . . 5,400 kg.
Specific pressure on ground . . . . . 0.4 kg/cm^2
Additional equipment . . . . . Separate-unit hydraulic control system with coupling device, power take-off shaft, reduction gear.

Tractor MTZ-5M

Type of tractor	Universal, wheeled, pneumatic tires
Type of engine	Diesel, four-stroke
Nominal horsepower of engine	40 h.p.
Specific fuel consumption	210 g/e.h.p./h.
Class of tractor	III
Maximum drawbar pull in low gear	1,400 kg.
Speed	0.78 to 13.8 km/h
Engine starting system	Electric starter
Modified model	MTZ-7 with four-wheel drive
Weight of tractor	2,870 kg.
Additional equipment	Separate-unit hydraulic control system with coupling device, power take-off shaft, driving pulley, reduction gear.

Tractor T-38

Type of tractor	Tracklaying, row-crop
Type of engine	Diesel, four-stroke
Nominal horsepower of engine	40 h.p.
Specific fuel consumption	210 g/e.h.p./h.
Class of tractor	IV
Maximum drawbar pull in first gear	2,000 kg.
Speed	3.8 to 9.05 km/h
Modified model	KD-35 for work in orchards and vineyards
Weight of tractor	4,000 kg.
Specific pressures on ground	0.6 kg/cm^2
Additional equipment	Separate-unit hydraulic control system with coupling device, power take-off shaft, pulley equipment, reduction gear.

Tractor DT-20

Type of tractor	Orchard-garden, reversible, wheeled with pneumatic tires
Type of engine	Diesel, four-stroke
Nominal horsepower of engine	18 h.p.
Specific fuel consumption	200 g/e.h.p./h.
Class of tractor	II
Maximum drawbar pull in low gear	720 kg.
Speed	0.87 to 17.6 km/h
Weight of tractor	1,460 kg.
Additional equipment	Separate-unit hydraulic control system, coupling device, driving pulley, power take-off shaft.

Immediate Farm Mechanization Goals

(1) To increase speed. Attempting to increase by at least 1.5 to 2.0 times for plowing, cultivating, and all major operations. For example, apparently they plow about 3 to 3.5 miles per hour and are attempting to develop equipment to plow 4.5 to 6 miles per hour.

(2) To electrify all farms within the next 6 or 7 years. We were told that at present all state farms are 100-percent electrified and that collective farms are 40-percent electrified. All machine and tractor stations are 100-percent electrified.

(3) To catch up with the U.S.A. in production of meat, milk, eggs, and other animal food products. We were told this over and over.

(4) To intensify the mechanization of farmsteads. Although we are ahead of the Russians in this respect, this is also one of the greatest problems in U.S. Agriculture.

Some Farm Equipment Developments of Interest

(1) Three-row corn pickers are in production and use, and we saw pictures of an experimental six-row corn picker. Unfortunately, we did not get to the corn picker production plant, but we saw several pieces of corn harvesting equipment. We saw under test 60 kinds of husking and snapping rolls, including snapping rolls operating at right angles to gathering chains.

(2) Six-row machine to cultivate, apply granular fertilizer, and apply herbicides, all in one operation.

(3) Forage harvester that pinches off the ears, then separates ears from stalks. Ears and chopped stalks are delivered in separate elevators from forage harvester to attendant trucks. Self-sharpening knives have been developed.

(4) The Russians go in for bigness. Examples:

(A) 21-foot side-delivery rake

(B) 48-foot dump rake

(C) 7 mowers on one tractor, each 7 feet long, and each mower operated with an electric motor powered from the tractor.

(5) Self-propelled pick-up baler. We saw being developed a two-chambered self-propelled pick-up baler. Objective is to bale hay from 110 acres per day.

(6) Well advanced in hydraulics and high-frequency electrode for metal coating. One of the delegation says the Russians have the best book known on hydraulics ("Oil Hydraulics" by Chaimovitsch of the Kiev Machine Construction Bureau). It has been published in German and one farm equipment firm in the United States has translated it into English.

(7) Experimental power take-off spreader. Has a hydraulic motor in front and behind. The movable bed is reversible so it can be used for either loading or unloading. Its approximate dimensions were 2 ft. deep, 6 ft. wide, 10 ft. long. Mounted on two large wheels.

(8) Large sledlike straw collector behind combine; and very large push-off stacker and push-off wagon platform for long hay.

(9) All tractors are Diesel and predominantly crawlers, but the movement is now toward wheel tractors. (American farm tractors are predominantly wheel type.) Some small tractors are air-cooled Diesels, and plans are to use air-cooled Diesels extensively.

(10) The U.S.S.R. has the uni-tractor concept in two types, small and large:

(A) The small version is a frame on which more than 20 attachments are used. The motor has been 1-cylinder, 14 h.p., air-cooled Diesel, but production is starting on 2-cylinder, 20 h.p., air-cooled Diesel.

(B) All-purpose chassis, 60 h.p., power steering. Attachments include: Combine (hydraulic controls), hydraulic dump wagon, forage harvester, corn and cotton picker, castor bean harvester, manure spreader, cultivator, swather baler, etc.

Conference with U. A. Frantsesson

Frantsesson, working on structure of soils in the new land, found that soil structure size greater than 1/4 mm. was important. He stated that large aggregates were destroyed rapidly by tillage, but that the soil remained productive with the smaller aggregates. He divided aggregates into two groups: (1) Water stable, those formed under grasses, and (2) conditionally stable, those formed by tillage. He explained that development of the new lands area was started in 1954, and 35 million hectares of new land had been brought into cultivation by 1957. A small amount of new land is still being brought into production, but the rapid expansion is over. New lands are still being developed in the humid sections by drainage. He stated that in the dry area they plan to use sod for 4 or 5 years and then a crop such as wheat, flax, or sugar beets for 2 or 3 years; in the humid area 1 or 2 years in sod, then a crop 1 or 2 years. Wheat residue is left on the surface in experiments only.

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